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TABLE OF CONTENTS ON PAGE 2

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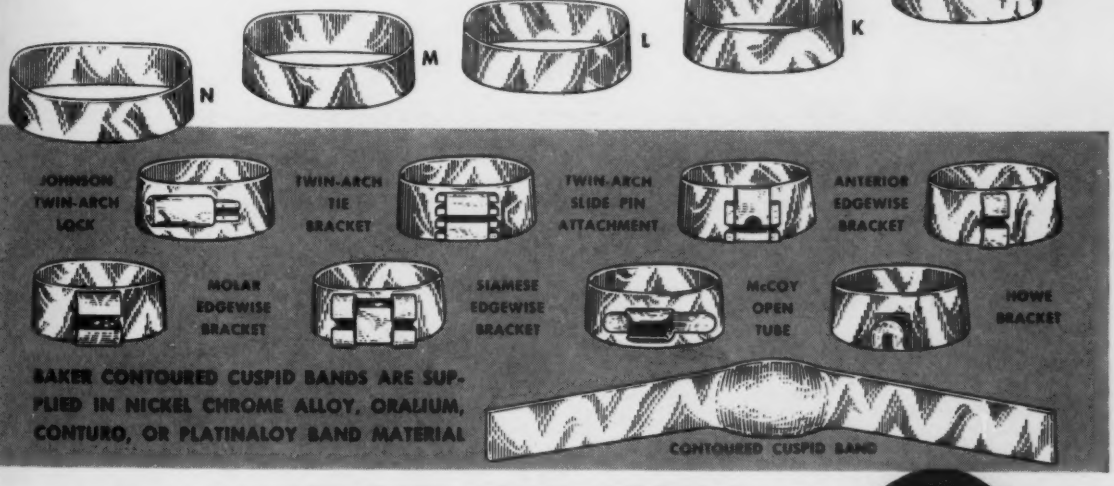
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CONTENTS FOR NOVEMBER, 1957

American Journal of Orthodontics

Original Articles

An Appraisal of the Effect of the Edgewise Arch Appliance in Modifying the Dentofacial Profile. Irving D. Buchin, D.D.S., Forest Hills, N. Y. ---------- 801

The Use of the Labio-Loop-Lingual Appliance in Class III and Deficiency Cases. William L. Wilson, D.M.D., Boston, Mass. ---------- 819

Disturbances in the Development of the Upper Jaw and the Middle Face. Gustav Korkhaus, M.D., D.M.D., Bonn, Germany ---------- 848

Orthodontic Profiles

Simeon Hayden Guilford. Andrew F. Jackson, D.D.S., Philadelphia, Pa. 869

In Memoriam

Lester H. Tate ---------- 873

Department of Orthodontic Abstracts and Reviews

Orthodontic Abstracts and Reviews ---------- 874

News and Notes

News and Notes ---------- 876

Officers of Orthodontic Societies

Officers of Orthodontic Societies ---------- 880

(Editorial and Business Communications on inside back cover)

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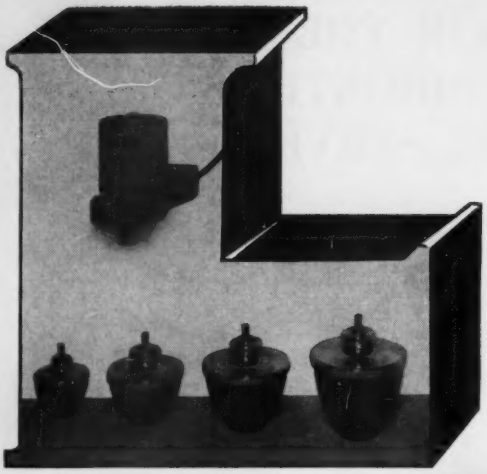

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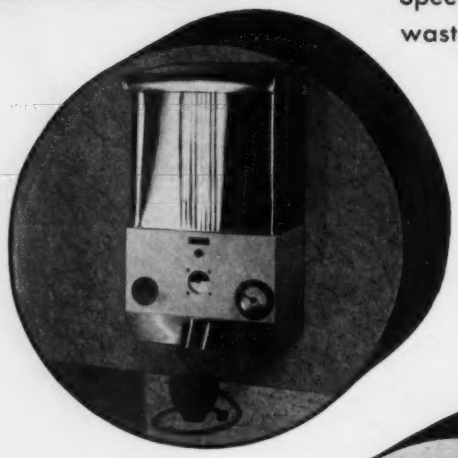

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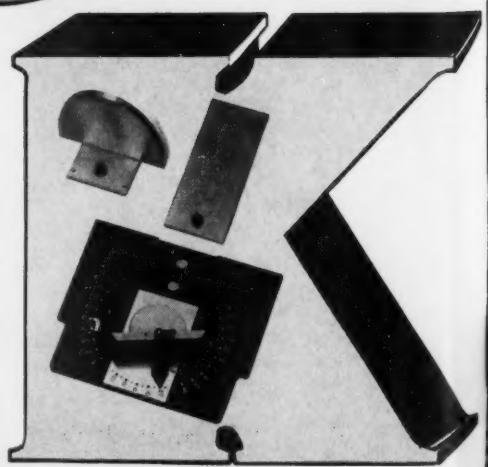

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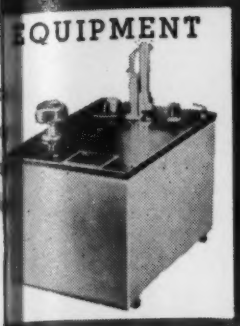

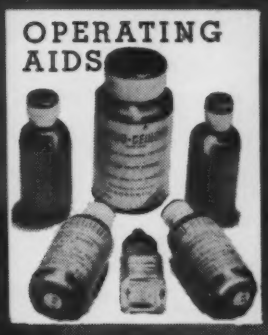

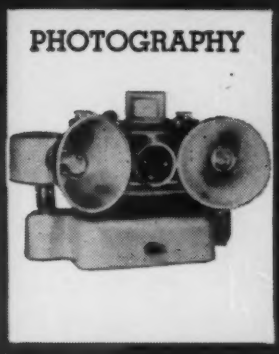

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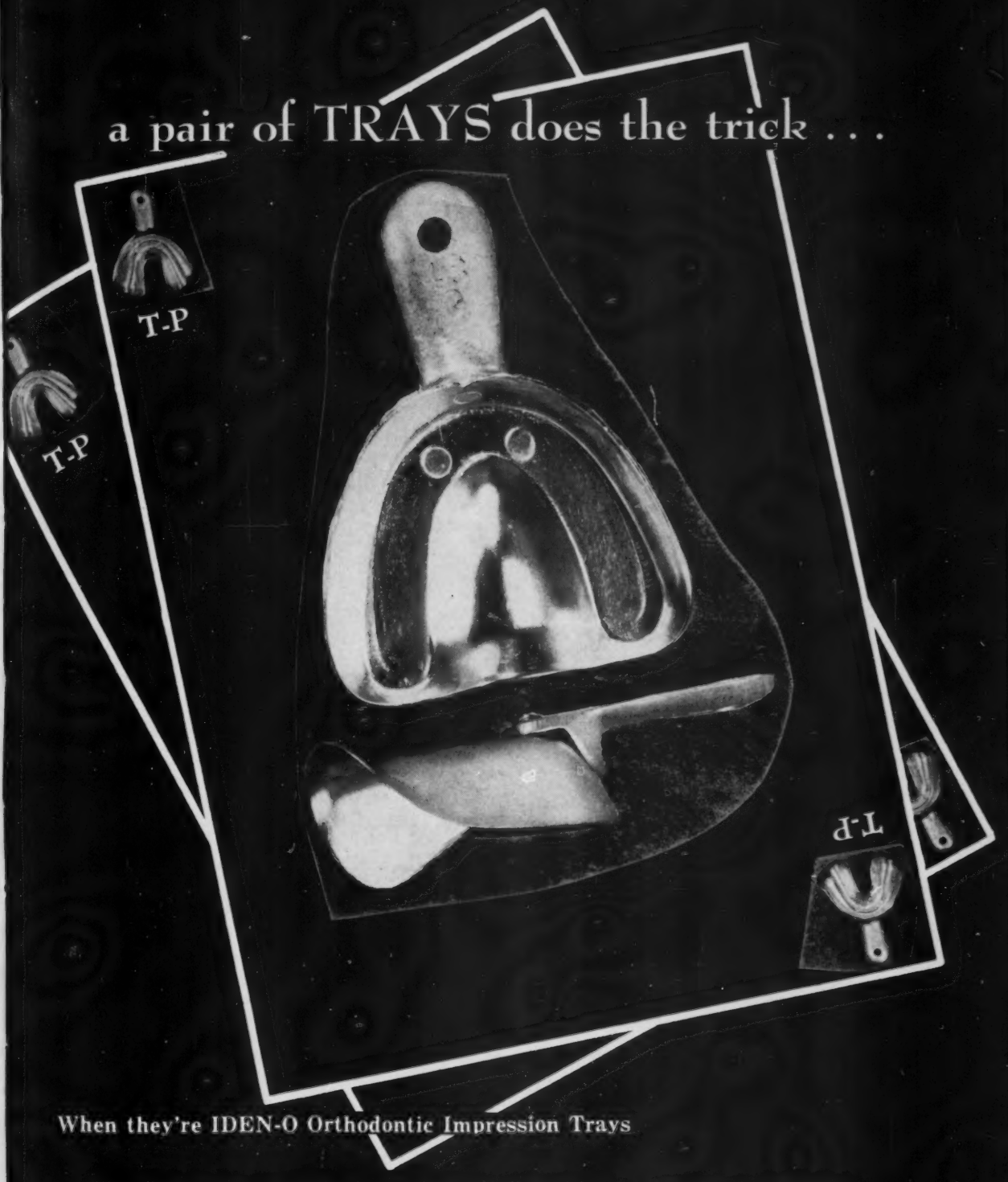

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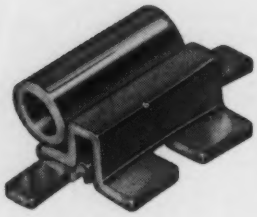

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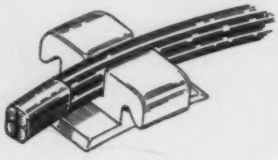

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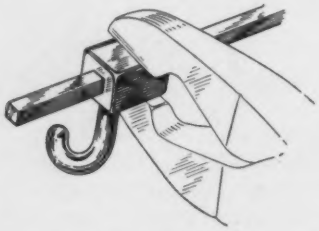

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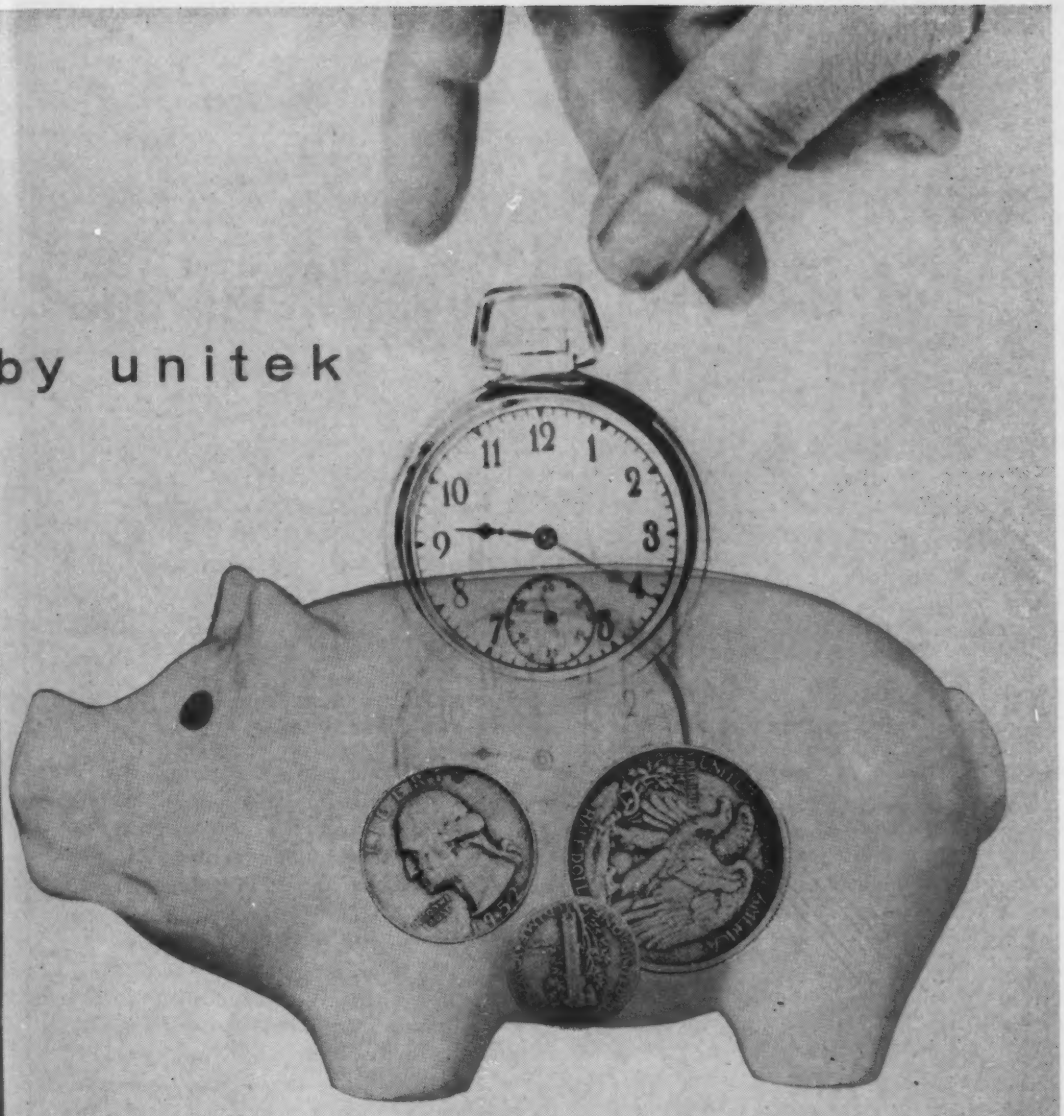

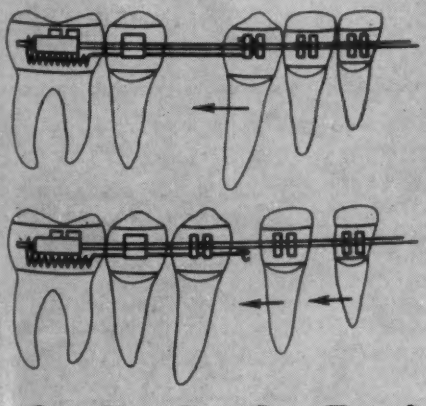

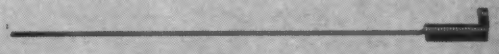

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Edited by **WILLIAM R. MANN**, M.S., D.D.S., Ann Arbor, Michigan. Associate Professor of Dentistry, School of Dentistry, and Associate Director, W. K. Kellogg Foundation Institute; Graduate and Postgraduate Dentistry, University of Michigan.

and **KENNETH A. EASLICK**, A.M., D.D.S., Ann Arbor, Michigan. Professor of Dentistry, School of Dentistry, University of Michigan.

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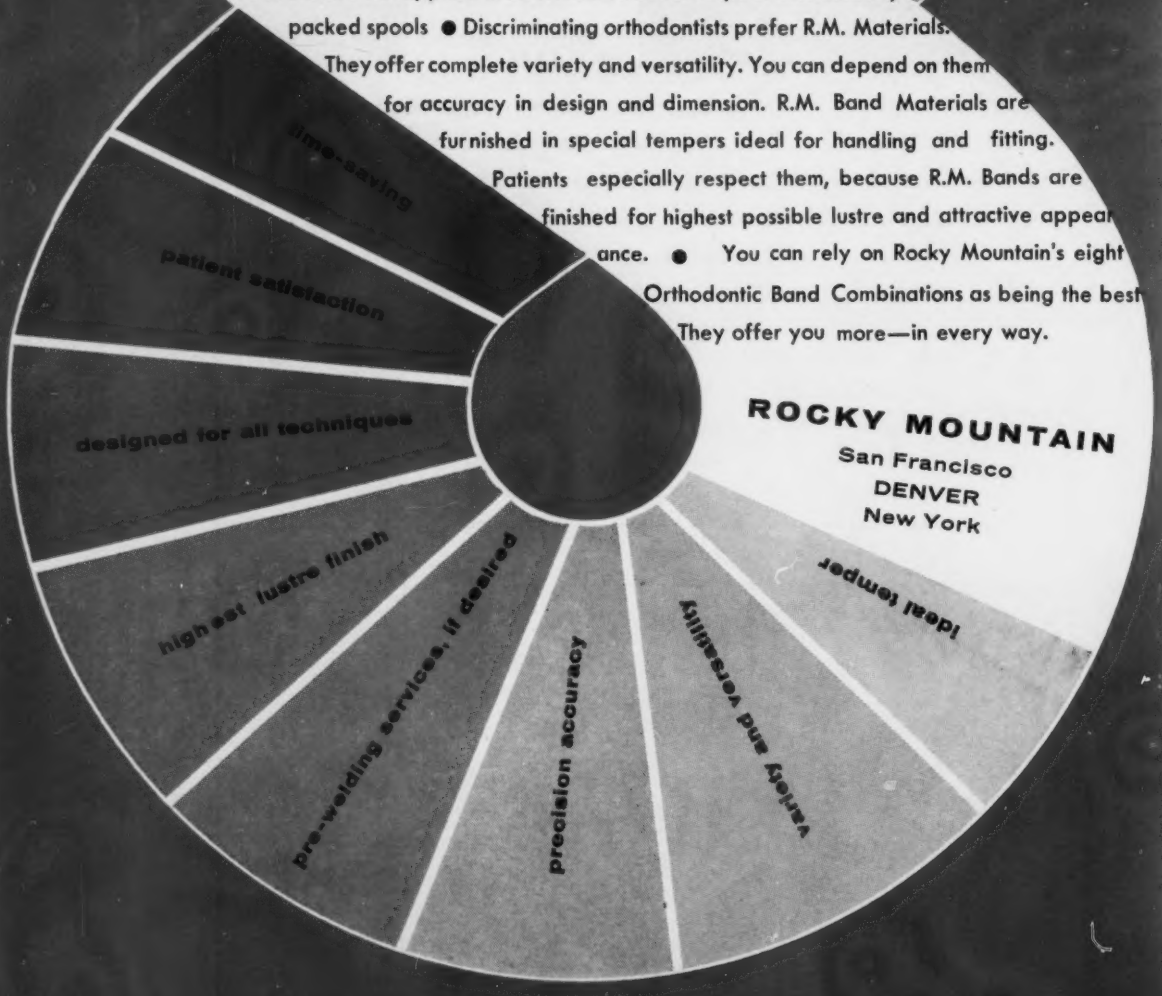

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Original Articles

AN APPRAISAL OF THE EFFECT OF THE EDGEWISE ARCH APPLIANCE IN MODIFYING THE DENTOFACIAL PROFILE

IRVING D. BUCHIN, D.D.S., FOREST HILLS, N. Y.

THE most gratifying experience that I have shared with my patients is the recognition and acknowledgment of the apparently dramatic change which occurs in the facial profile as a result of orthodontic treatment. Unfortunately, this is not a generalization which applies to every patient. However, the edgewise arch mechanism, coupled with a Tweed concept, holds the greatest potentiality for improvement in facial esthetics.

I will be presumptuous enough to assume that most of us would like to see our chinless patients with protuding teeth and curled-up lips evidence, as a result of treatment, straighter profiles, teeth which remain within the oral cavity, and lips which meet without restraint.

Orthodontic clichés have influenced orthodontic thought in the past ten years; this unquestionably resulted from cephalometric evaluation and research which, in essence, was excellent. Thus, we hear that the effects of orthodontic treatment are limited to the teeth and alveolar process, arch length and arch width are dictated by original dimensions, the morphogenetic pattern of the face is established at birth, and rest position or change in length and tonicity of muscle fiber is not affected by orthodontic treatment. These are the present pillars of orthodontic thought.

Presented at the fall meeting of the Northeastern Society of Orthodontists, Hartford, Connecticut, October, 1956.

As Wylie[1] aptly put it, it was not scientific progress which produced these rigid doctrines circumscribing orthodontics, but rather the tendency on the part of many of us to convert into catch phrases the capsule summaries of careful investigation.

The role of various types of mechanics in the treatment of orthodontic problems is constantly undergoing cephalometric evaluation by clinicians and researchers. However, the big question which cannot be scientifically answered, since we lack standard control procedures, is: Do our results reflect mechanotherapy or the effect of growth while the patient is undergoing treatment? Silverstein's[2] studies on the effect of treatment on the growth rate of certain bony facial profile areas in Class II, Division 1 malocclusions, in both treated and untreated cases, is an excellent start toward helping to solve this question.

Another excellent evaluation was recently concluded by the Indianapolis Study Group, made up of Stoner, Lindquist, Vorhies, Hanes, Hapak, and Haynes.[3] This group comprehensively analyzed the results of fifty-seven consecutive cases treated by Tweed. Their evaluation, though open to further appraisal, is significant in many ways. First, it was a comprehensive survey of the exact nature of change produced by one man in a large number of cases. Second, the cases analyzed represent the results achieved by one of our most gifted clinicians, and not by inexperienced students. Finally, these cases did not represent any particular type, but were a cross section of Tweed's routine practice and were consecutively treated.

Approximately 5,000 measurements were made, and some of the more significant findings were:

1. The anterior portion of the maxillary base is moved to a more backward position than the forward movement of the chin point.
2. There is a significant reduction in SNA and SNB differences in many cases.
3. There is no predictability to the position of the mandible as a result of treatment. As many can go distally as those that come forward. Some remain in relatively the same position.
4. Soft-tissue changes in the dentofacial profile resulted from the bodily retraction of upper anterior teeth and the backward movement of the premaxilla region, increase in vertical height as the result of growth, and the depression of anterior teeth, all of which abetted facial improvement.

The work of the Indianapolis Study Group motivated me to evaluate the last fifty-seven cases which I completed. If, basically, I used an edgewise appliance and a similar concept, and if my technique is as meticulous and thorough as Tweed's, would my end results demonstrate similar conclusions? If my concept of treatment remains constant, but my mechanotherapy differs for similar types of malocclusion, would this difference in mechanics reflect itself in differences in growth response, differences in facial changes, and differences in

the final stability of the dentition? If carefully prepared mandibular anchorage with tip-backs on the buccal segments and lingual inclining of the anterior teeth is utilized to resist the pull of a Class II elastic, would the mandible reposition or grow in a relatively more forward direction than mandibular anchorage without tip-backs? Does treatment inhibit the growth of the maxilla in Class II, Division 1 malocclusions?

If there is a marked discrepancy between the anterior limits of basal bone of the maxilla point *A* and the mandible point *B*, does the action of Class II mechanics and lingual root torque on the maxillary anterior teeth negate the differences? Finally, how do I explain dramatic facial changes in certain instances and failures in others?

Modus Operandi.—At the beginning of treatment a hard-tissue cephalogram, a soft-tissue cephalogram, right and left lateral plates, a fourteen film intraoral series, models, and photographs are made of each patient. The same clinical records are completed six months after the removal of all orthodontic appliances, with the exception of the retainer if one is used. Two cephalographic tracings are made of each case, one at the beginning and one at the termination of treatment. These tracings consist of a combination of Wylie's analysis, Downs's analysis, and the SNA-SNB difference.

Personally, I have always encountered difficulty in relating and tracing the angulation of mandibular incisors to the mandibular plane. Superimposition of crowns and roots on a one-plane surface leaves a lot to the imagination with respect to the exact axial position of the lower anterior teeth.

The combined analysis yields the following information:

1. The linear dimensions of the mandible and maxilla in an anteroposterior direction, expressed in millimeters. Thus, the extent of anteroposterior growth of the tooth-bearing bones during treatment can be easily ascertained.
2. The linear dimensions, expressed in millimeters, of the cranial base in an anteroposterior direction of the terminal position of the maxilla, pterygomaxillary notch to sella turcica; sella turcica to the glenoid fossa; and the first maxillary molar in relationship to the pterygomaxillary notch.
3. Linear dimension, expressed in millimeters, as to the protrusion of the crowns of the upper anterior teeth to the facial plane and the extent of the most outward part of the soft-tissue chin point to the facial plane.
4. Angular measurements indicating relative positions to each other, such as the facial angle, the Frankfort-mandibular angle, the Y axis to the Frankfort plane, and the SNA and SNB differences.

The cases selected for presentation were the most extreme of the fifty-seven malocclusions evaluated, as far as impairment in facial esthetics is concerned.

In ascertaining the results of my treatment, it is essential to understand the basic premises of my mechanotherapy. Since I wish to enhance facial

esthetics and, if possible, to encourage mandibular growth to its fullest genetic potential, careful mandibular anchorage to withstand the effects of Class II mechanics is the cornerstone of treatment. I have hoped that at the same time this would inhibit or hold back the anterior limit of the maxilla or point A. The only time the lower anterior teeth would be permitted to come forward is in the few selected cases in which lower incisors are distal to the facial plane and the position of the mandible is in good relationship to the cranial base.

Teeth are removed in all discrepancy cases and also in those cases in which mandibular anchorage would be difficult in maintaining the upright position of the lower incisors. Wherever possible, homogeneous teeth are removed. However, this procedure must often be altered because of missing teeth, extreme rotation, pulp involvements and anomalous teeth. In all cases, with the exception of cross-bite, arch expansion is not a procedure of treatment.

Basically, all cases are divided into two categories:

Category 1: This represents any case in which mandibular anchorage is a problem. In these cases there is no extraction space available in the mandibular arch after the distal retraction of the mandibular canines. In addition, the repositioning of the lower anterior teeth is not sufficiently inclined lingually to withstand successfully the pull of Class II mechanics. These cases would best be treated by a typical Tweed procedure involving Class III mechanics and tip-back bends applied to the mandibular arch.

Category 2: These are the cases in which sufficient extraction space is available distal to the mandibular canines to take up the pull of the force of the Class II elastic. This strategic space exists after the lingual repositioning of the lower anterior teeth. In these cases, tip-back bends and Class III mechanics are not utilized prior to the utilization of Class II mechanics. Thus, this category represents patients treated according to the Bull technique.

If, during utilization of Class II mechanics in these cases, the strategic space is lost before final correction of the mandibular-maxillary dental relationship, and if the lower anterior teeth start to tip labially, then Class II mechanics are stopped and typical Tweed mandibular anchorage with tip-back bends and Class III mechanics is initiated.

Space limitations make it necessary to restrict the number of cases illustrated. Consequently, nine cases treated typically with the Tweed technique (Figs. 1 to 9) and nine cases treated typically with the Bull technique (Figs.

Fig. 1.—Tweed technique. Class II, Division 1 malocclusion. Mandibular anchorage preparation with tip-backs and Class III mechanics. Extraction of upper first premolars and lower first molars. FMA 32 degrees. Pretreatment SNA 77 degrees, SNB 71 degrees, a difference of 6 degrees. Posttreatment SNA 76 degrees, SNB 71 degrees, a difference of 5 degrees.

Fig. 2.—Tweed technique. Class II, Division 1 malocclusion. Mandibular anchorage preparation with tip-back and Class III mechanics. Upper first premolars and lower first molars removed. FMA 34 degrees. Pretreatment SNA 83 degrees, SNB 75 degrees, a difference of 8 degrees. Posttreatment SNA 83 degrees, SNB 77 degrees, a difference of 6 degrees.

Fig. 1.

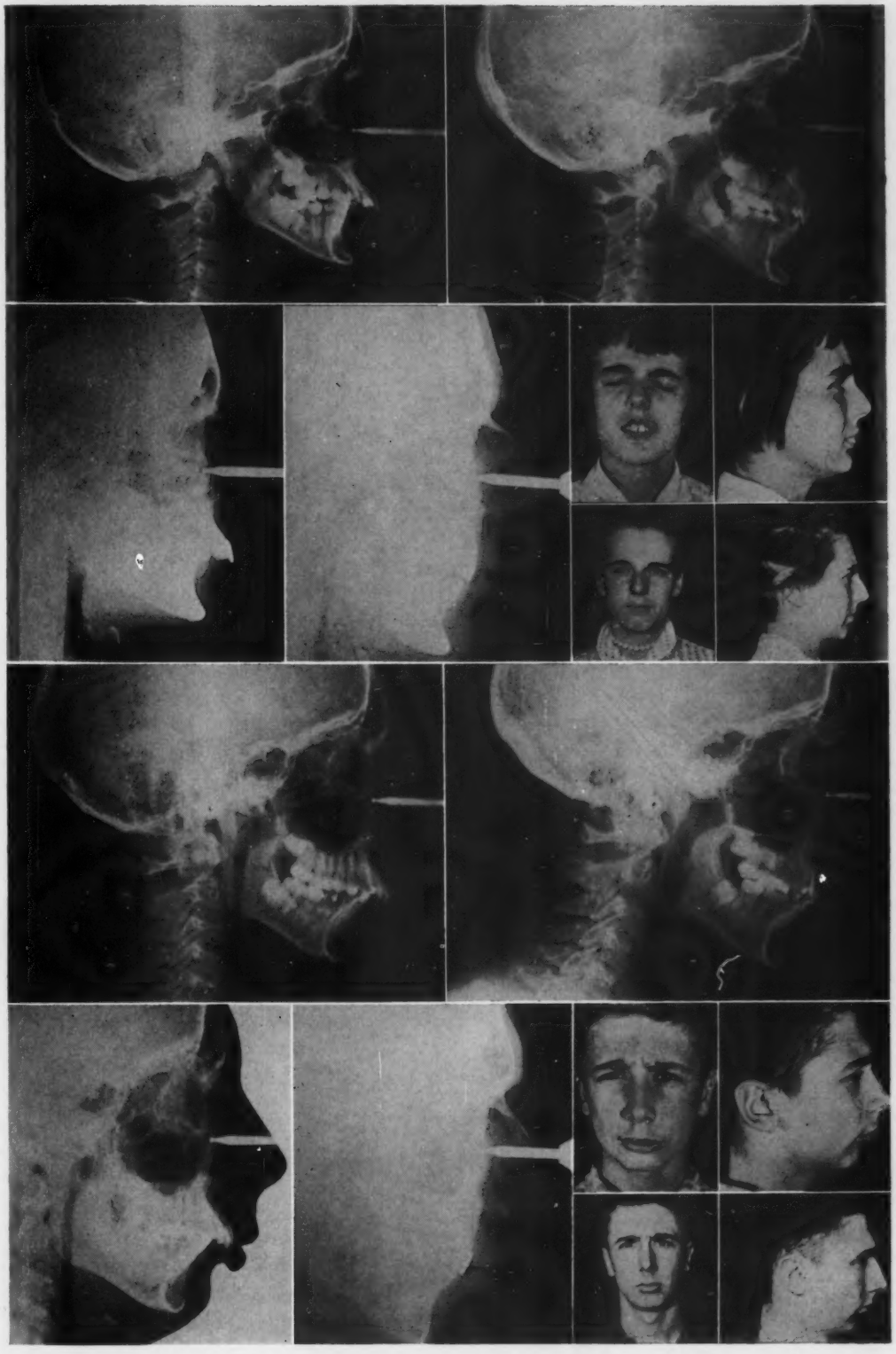

Fig. 2.

(For legends, see opposite page.)

Fig. 3.

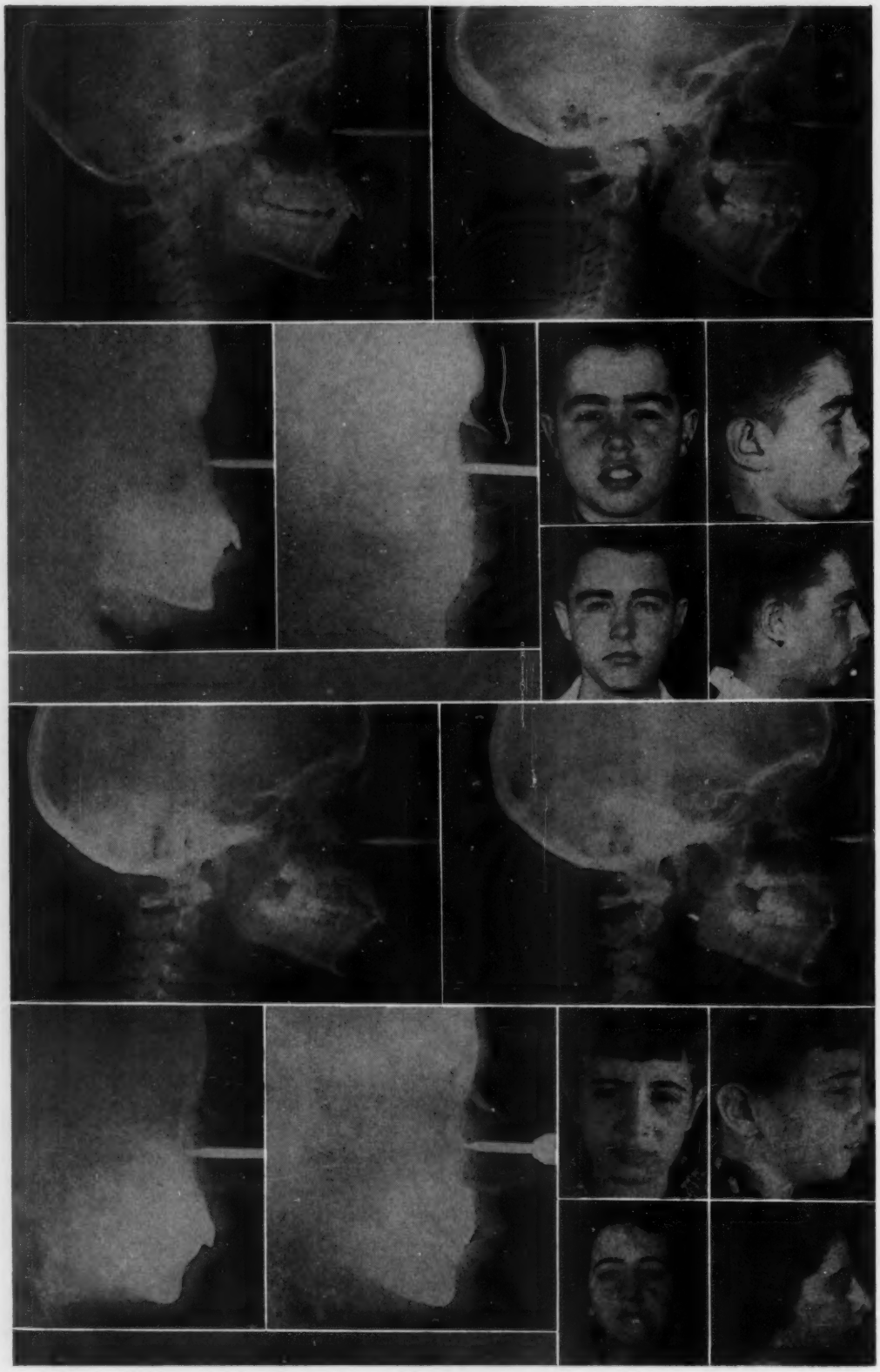

Fig. 4.

(For legends, see opposite page.)

10 to 18) are illustrated. One case, No. 19, illustrates a headcap treatment of the maxillary arch with an edgewise appliance in which the mandibular arch is left untreated. "Before and after" cephalograms, most with "before and after" soft-tissue profiles, as well as "before and after" photographs, are included in the illustrations.

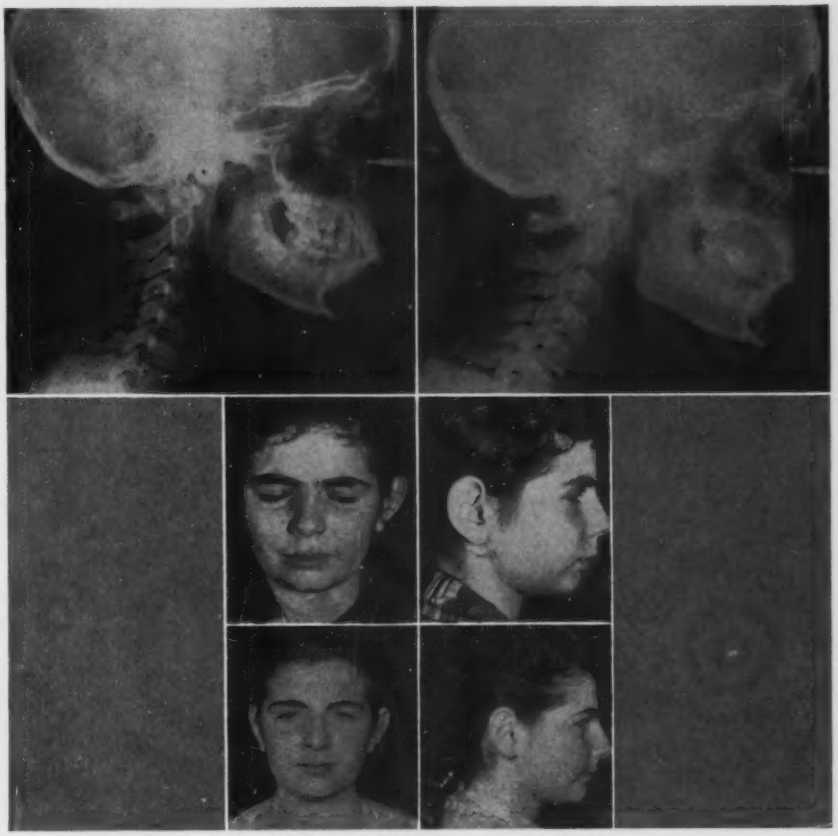

Fig. 5.—Tweed technique. Class I bimaxillary protrusion. Mandibular anchorage preparation with tip-backs and Class III mechanics. Four first premolars removed. FMA 31 degrees. Pretreatment SNA 87 degrees, SNB 80 degrees, a difference of 7 degrees. Posttreatment SNA 85 degrees, SNB 79 degrees, a difference of 6 degrees.

DISCUSSION

The most obvious change in the facial profile as the result of treatment is the change in the contour of the upper and lower lips, permitting them to meet with less tension as a result of the distal retraction of anterior teeth.

Fig. 3.—Tweed technique. Class II, Division 1 malocclusion. Mandibular anchorage preparation with tip-back and Class III mechanics. Four first premolars removed. FMA 23 degrees. Pretreatment SNA 84 degrees, SNB 76 degrees, a difference of 8 degrees. Posttreatment SNA 81 degrees, SNB 74 degrees, a difference of 7 degrees.

Fig. 4.—Tweed technique. Class I bimaxillary protrusion. Mandibular anchorage preparation with tip-back and Class III mechanics. Four first premolars removed. FMA 30 degrees. Pretreatment SNA 83 degrees, SNB 77 degrees, a difference of 6 degrees. Posttreatment SNA 84 degrees, SNB 79 degrees, a difference of 5 degrees.

Fig. 6.

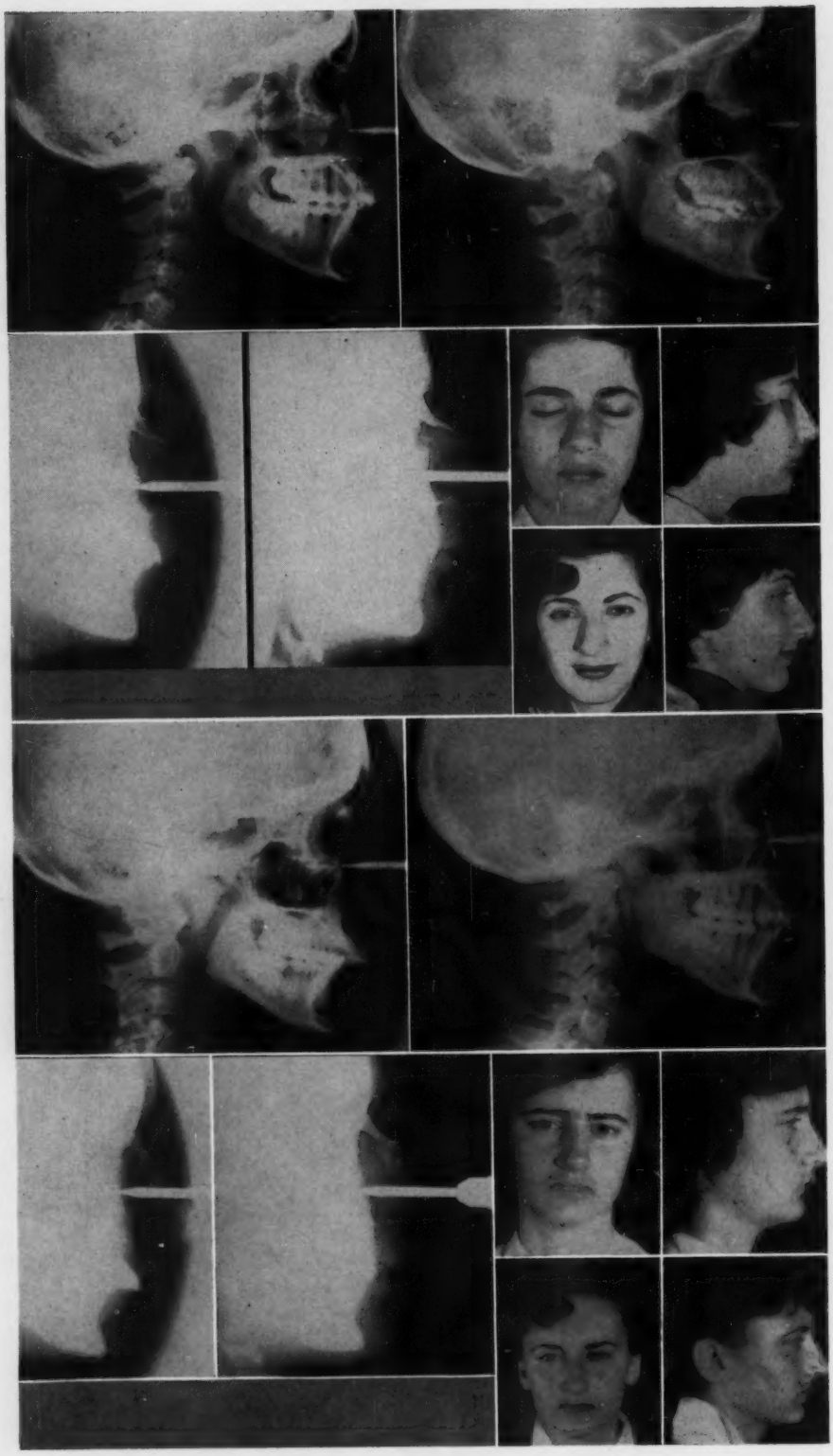

Fig. 7.

Fig. 6.—Tweed technique. Class I malocclusion. Mandibular anchorage preparation with tip-back and Class III mechanics. Four first premolars removed. FMA 30 degrees. Pretreatment SNA 86 degrees, SNB 79 degrees, a difference of 7 degrees. Posttreatment SNA 84 degrees, SNB 78 degrees, a difference of 6 degrees.

Fig. 7.—Tweed technique. Class II, Division 1, malocclusion. Mandibular anchorage preparation with tip-backs and Class III mechanics. Extraction of four first premolars. FMA 34 degrees. Pretreatment SNA 78 degrees, SNB 73 degrees, a difference of 5 degrees. Posttreatment SNA 78 degrees, SNB 74 degrees, a difference of 4 degrees.

Fig. 8.

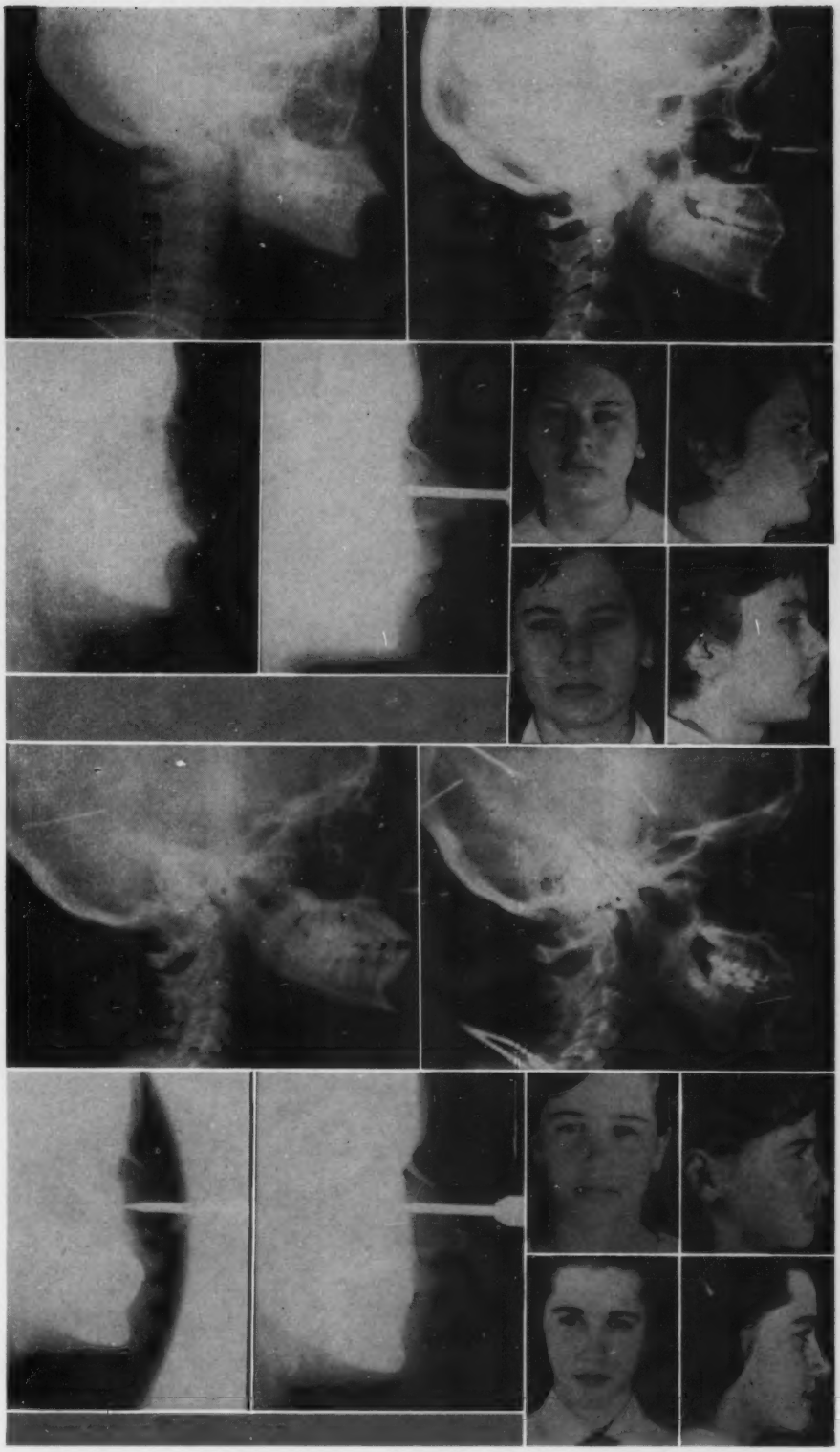

Fig. 9.

Fig. 8.—Tweed technique. Class II, Division 1 malocclusion. Mandibular anchorage prepared with Class III mechanics. Nonextraction case. FMA 30 degrees. Pretreatment SNA 82 degrees, SNB 78 degrees, a difference of 5 degrees. Posttreatment SNA 83 degrees, SNB 78 degrees, a difference of 5 degrees.

Fig. 9.—Tweed technique. Class I malocclusion, bimaxillary protrusion. Mandibular anchorage prepared with Class III mechanics and four first premolars removed. FMA 26 degrees. Pretreatment SNA 88 degrees, SNB 86 degrees, a difference of 2 degrees. Posttreatment SNA 86 degrees, SNB 84 degrees, a difference of 2 degrees.

Fig. 10.

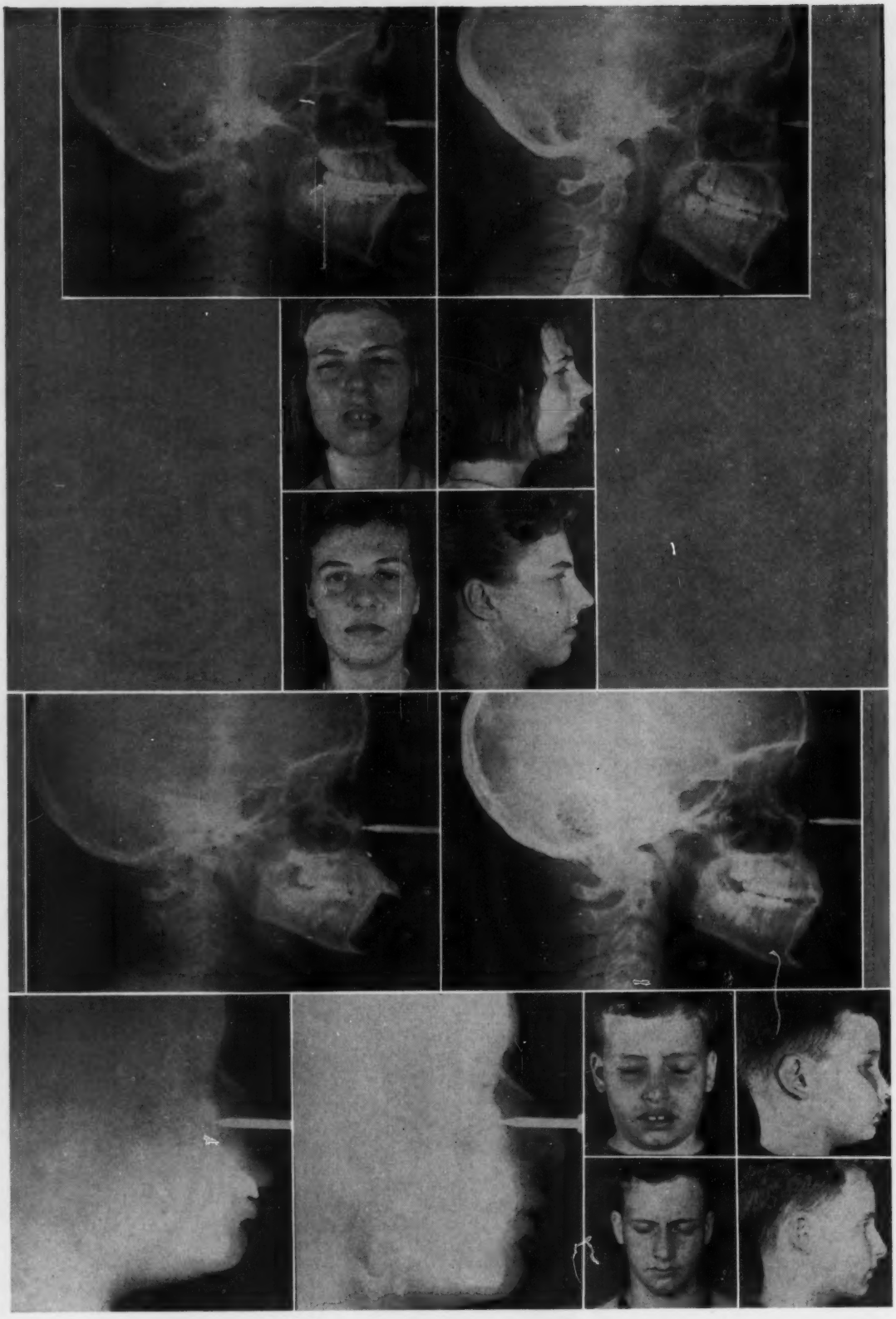

Fig. 11.

Fig. 10.—Bull technique. Class II, Division 1 malocclusion. No Class III mechanics or tip-backs used on mandibular arch. Four first premolars removed. FMA 35 degrees. Pretreatment SNA 89 degrees, SNB 77 degrees, a difference of 12 degrees. Posttreatment SNA 85 degrees, SNB 77 degrees, a difference of 8 degrees.

Fig. 11.—Bull technique. Class II, Division 1 malocclusion. Four first premolars removed. FMA 29 degrees. Pretreatment SNA 89 degrees, SNB 82 degrees, a difference of 7 degrees. Posttreatment SNA 84 degrees, SNB 79 degrees, a difference of 5 degrees.

Fig. 12.

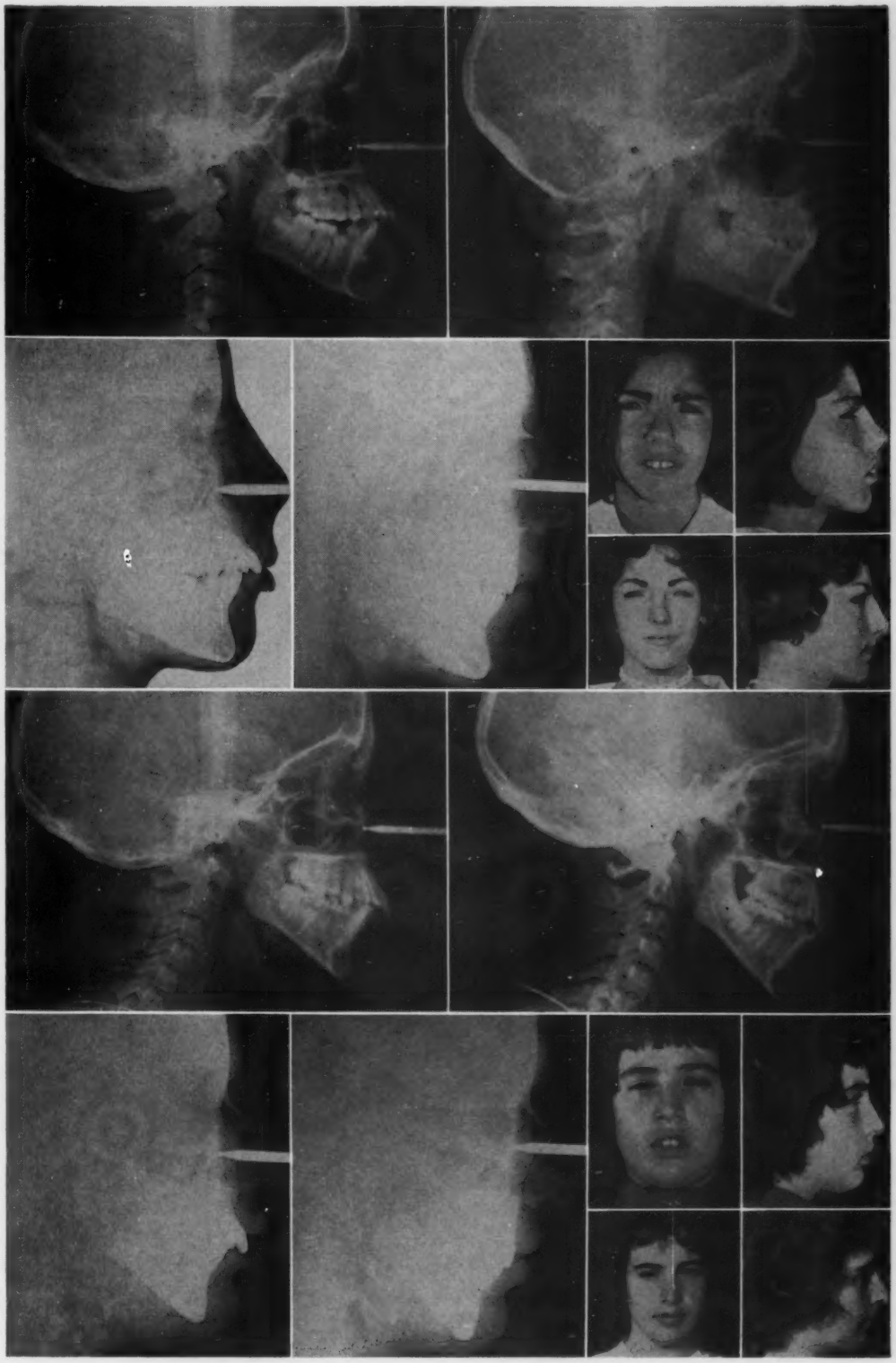

Fig. 13.

Fig. 12.—Bull technique. Class II, division 1 malocclusion. No Class III mechanics or tip-backs used on mandibular arch. Four first premolars removed. FMA 38 degrees. Pretreatment SNA 87 degrees, SNB 77 degrees, a difference of 10 degrees. Posttreatment SNA 83 degrees, SNB 75 degrees, a difference of 8 degrees.

Fig. 13.—Bull technique. Class II, Division 1 malocclusion. No Class III mechanics or tip-backs used on mandibular arch. Four first premolars removed. FMA 42 degrees. Pretreatment SNA 80 degrees, SNB 73 degrees, a difference of 7 degrees. Posttreatment SNA 80 degrees, SNB 74 degrees, a difference of 6 degrees.

Fig. 14.

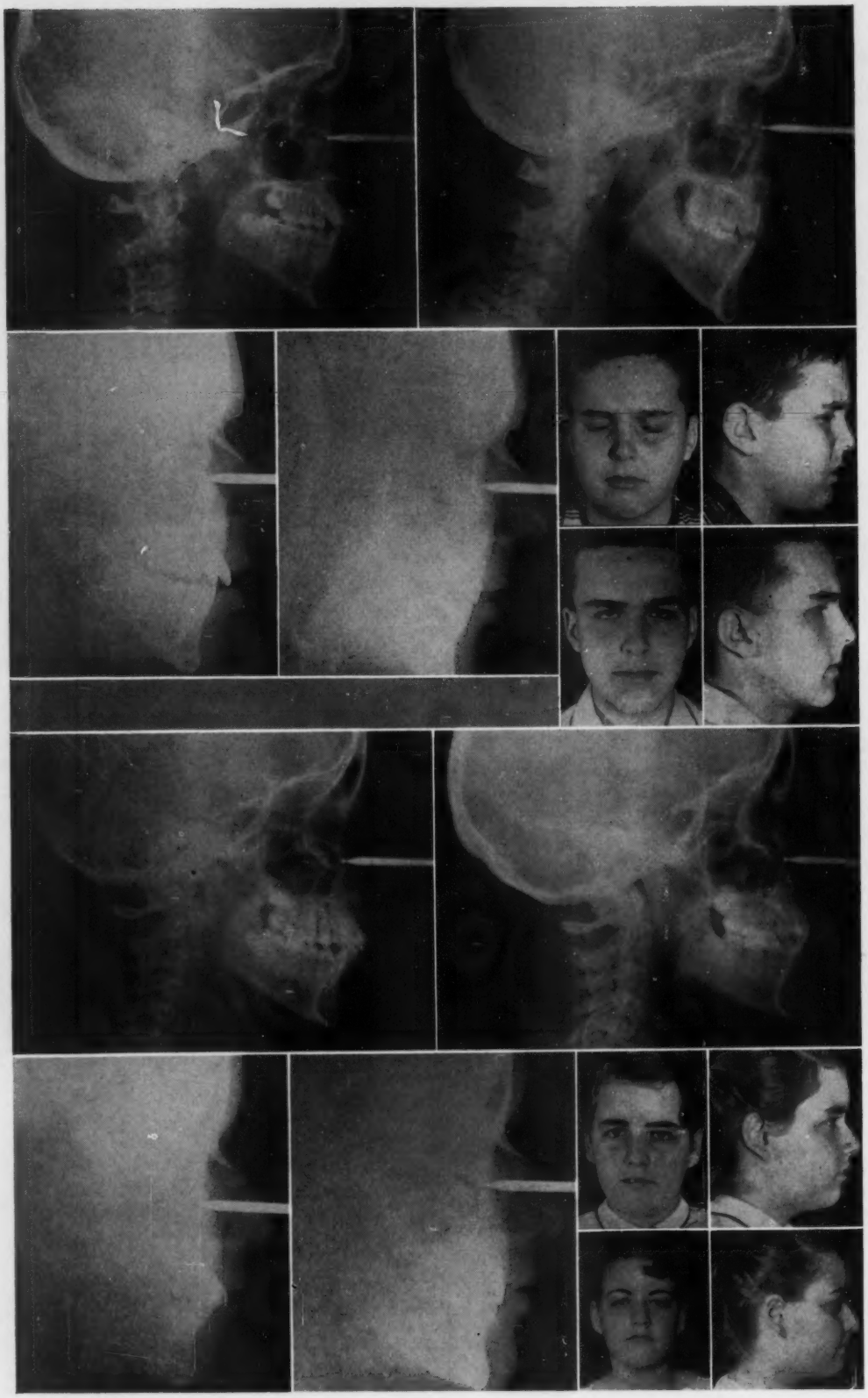

Fig. 15.

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Obviously, the greater the retraction of the lower anterior teeth, the greater the reduction possible in maxillary overjet and protrusion. In most instances this results in emphasizing pogonion.

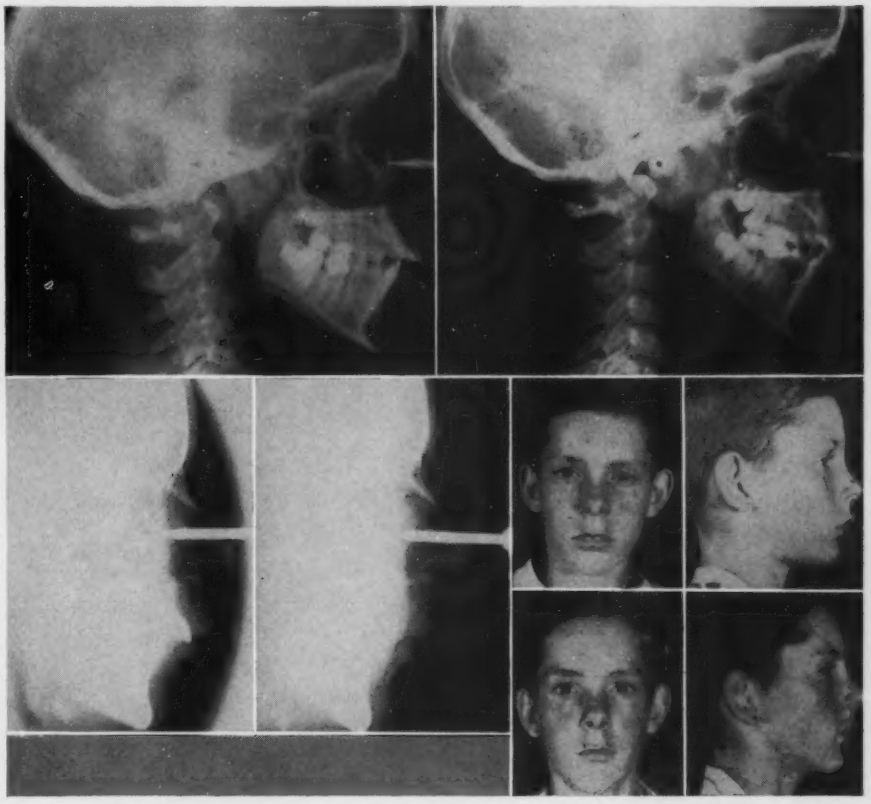

Fig. 16.—Bull technique. Class II, Division 1 malocclusion. No Class III mechanics or tip-backs used on mandibular arch. Four first premolars removed. FMA 32 degrees. Pretreatment SNA 77 degrees, SNB 71 degrees, a difference of 6 degrees. Posttreatment SNA 74 degrees, SNB 69 degrees, a difference of 5 degrees.

The second most obvious change in all treated cases is the increase in vertical height in the lower third of the face. This unquestionably is due to a combination of growth of the face in a forward and downward direction, as well as the elevation of posterior buccal segments and the depression of the upper anterior teeth.[4] The permanence of such a change can be ascertained only with further cephalograms and photographs two or three years after retention.

Fig. 14.—Bull technique. Class I malocclusion. No Class III mechanics or tip-backs used on mandibular arch. Four first premolars removed. FMA 36 degrees. Pretreatment SNA 80 degrees, SNB 75 degrees, a difference of 5 degrees. Posttreatment SNA 77 degrees, SNB 75 degrees, a difference of 2 degrees.

Fig. 15.—Bull technique. Class I malocclusion. No Class III mechanics or tip-backs used on mandibular arch. Four first premolars removed. FMA 40 degrees. Pretreatment SNA 80 degrees, SNB 77 degrees, a difference of 3 degrees. Posttreatment SNA 80 degrees, SNB 77 degrees, a difference of 3 degrees.

Third, ethnic considerations, heavy-set lips, convex profiles, and large, noses can minimize our orthodontic efforts in improving the dentofacial profile.

Fourth, there was no significant difference in improvement of facial esthetics where anchorage preparation with tip-backs was used, as compared with treatment without tip-backs as used in the Bull technique. This is true only as long as the anterior teeth in the latter were not permitted to migrate mesially from the pull of the Class II elastic. However, there were significant differences in the correction of overbite when tip-backs were used.

Fig. 17.—Bull technique. Class II, Division 1 malocclusion. No Class III mechanics or tip-backs used on mandibular arch. Three first premolars removed; upper left first molar previously extracted. FMA 37 degrees. Pretreatment SNA 93 degrees, SNB 86 degrees, a difference of 7 degrees. Posttreatment SNA 93 degrees, SNB 86 degrees, a difference of 7 degrees.

Fifth, surprisingly, even though strong Class II elastics were used in almost every case, the mandible as a rule did not come forward during treatment. In most instances, it remained in relatively the same position. It came mesially as often as it went distally. There was some appositional growth at the symphysis which did cause some recontouring of pogonion.

Sixth, the anterior extent of the maxilla can be held in relatively the same position while the remainder of the face continues its downward and forward growth.

Seventh, the most dramatic change in facial profile occurred in conjunction with an increase in the anteroposterior growth of the mandible in greater proportion than that which occurred in the maxilla and in other sections of the cranial base. Unfortunately, there were many instances in similar malocclusions with the same treatment in which the mandible showed no greater growth than that of the maxilla.

Eighth, since growth has a specific locus, duration, and intensity, it is significant that the best mandibular response to treatment with Class II mechanics occurred in the patients treated before the eruption of second molars. Those patients who were started with second molars in the line of occlusion showed the least change in the dentofacial pattern. Thus, it appears that if we are to affect the growth potential, we must start treatment when the patient is at an early age.

Fig. 18.—Bull technique. Class II, Division 1 malocclusion. No Class III mechanics or tip-backs used on mandibular arch. Four first premolars removed. FMA 37 degrees. Pretreatment SNA 87 degrees, SNB 74 degrees, a difference of 13 degrees. Posttreatment SNA 85 degrees, SNB 76 degrees, a difference of 9 degrees.

Ninth, Silverstein,[2] in his analysis of trends in untreated Class II, Division 1 cases at the University of Illinois, showed that the angles SNA-SN-AN indicated very little change in angulation from the ages of 8 to 20 years. Pelton

and Elsasser,[5] in a facial profile evaluation of 6,829 subjects ranging in age from 5 to 24 years, indicated that the face becomes more prognathic with advancing age; the face is more convex and they state: "The facial profile will not straighten with growth. Thus the orthodontist cannot hope that the profile will improve with age without orthodontic intervention." The maxilla can be held in relatively the same position while the remainder of the face continues its downward and forward growth. Consequently, since many of my treated cases showed a slight to moderate reduction in SNA, I assume that the relative

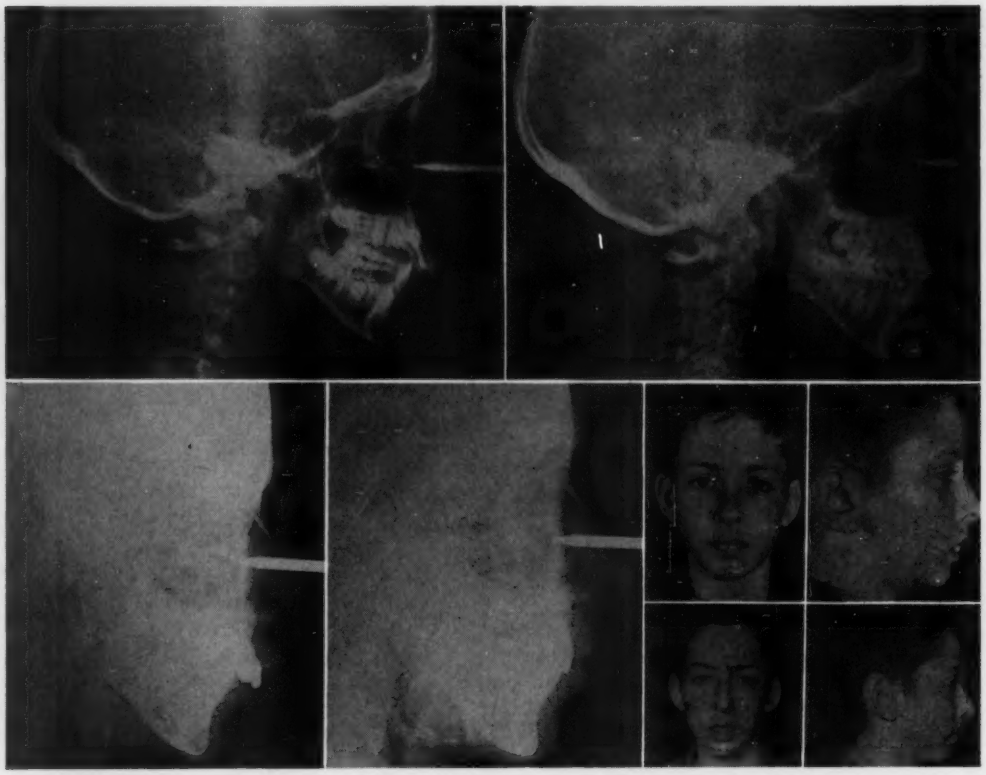

Fig. 19.—Extraoral force. Class II, Division 1 malocclusion. Occipital headgear and edgewise bands to upper arch only. Mandible untouched during three years of headcap use. FMA 38 degrees. Pretreatment SNA 78 degrees, SNB 70 degrees, a difference of 8 degrees. Posttreatment SNA 76 degrees, SNB 70 degrees, a difference of 6 degrees.

reduction in the anterior angle of the surface of the maxilla in the midsagittal plane is caused by mechanotherapy rather than the forward and downward growth of the cranial base. The mechanics involved in the reduction of angle SNA is strong Class II elastics with anterior lingual root torque on the maxillary arch. Urban,[6] in a cephalometric study of orthodontic treatment using an upper appliance with occipital anchorage, averaged approximately a 1 degree decrease in SNA in a series of five cases treated without Class II mechanics in which the mandible was not disturbed. His greatest reduction in SNA was 1½ degrees in one case, while another remained unchanged and a third increased 1 degree. With the use of strong Class II elastics, plus extraoral force plus lingual root torque, some of my cases exhibited reductions from 3 to 5 degrees.

This again emphasizes the importance of Class II elastics and the necessity for careful mandibular anchorage preparation, if we are to enhance the possibilities for improvement in facial esthetics. In my analysis, those poor facial profiles treated in the maxillary arch with extraoral force as a substitute for anchorage preparation of the mandibular arch and Class II mechanics showed the least improvement in facial esthetics.

In the analysis of fifty-seven finished cases, I could find no significant correlation between the Frankfort-mandibular plane angle and the prognosis for improvement of facial esthetics. Some of my most dramatic changes in the soft-tissue profile had Frankfort-mandibular angles of 42, 40, and 37 degrees, whereas in similar malocclusions where the Frankfort-mandibular angles were in the 20- or low 30-degree range the change in facial profile was not unusual. On analysis, the difference in response was due to a combination of two factors, namely: (1) an increased anteroposterior growth of the mandible and (2) accompanied with a reduction or relatively the same position of point A or the anterior limit of basal bone of the maxilla relative to the cranial base.

CONCLUSIONS

The dentofacial pattern can be greatly improved as a result of orthodontic treatment. Most often this improvement is the result of the distal retraction of the maxillary teeth and the reduction or the holding in place of the anterior limit of maxillary basal bone or point A. If the mandible shows a significant increase in anteroposterior dimensions during this interval, the change in facial profile becomes dramatic. This is also true in high-FMA cases. The timing for the aforementioned appears more likely before the eruption of the twelve-year molars. The use of extraoral force as a substitute for Class II mechanics is very effective in moving teeth, but much less effective in improving a poor dentofacial pattern.

The use of Class II mechanics is very effective in reducing SNA and at times in aiding in the anteroposterior growth of the mandible. Surprisingly, the use of Class II mechanics is not significant in repositioning the mandible forward. There was no significant difference in improvement of facial esthetics when mandibular anchorage preparation with tip-backs was used, as compared with treatment without tip-backs as used in the Bull technique, so long as the anterior teeth in the latter were not permitted to tip labially from the pull of Class II mechanics. However, anchorage loss was more readily forestalled when tip-backs were used. Differences in the configuration of the mandible at the symphysis, relationship of the lower anterior teeth to the facial plane, and the extent of the soft tissue in this locale are subjects which require further investigation with respect to their role in facial esthetics.

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THE USE OF THE LABIO-LOOP-LINGUAL APPLIANCE IN CLASS III AND DEFICIENCY CASES

WILLIAM L. WILSON, D.M.D., BOSTON, MASS.

IT WAS a privilege to appear before this Society two years ago and discuss the use of the labio-loop-lingual appliance in Class II cases. A wide variety of cases was presented to show variations in appliance use. It is a further privilege to be invited to continue this discussion. At this time I shall demonstate the use of the appliance in Class III cases and in the broad spectrum of deficiency cases where either extraction or arch increase is indicated.

Too much emphasis has been placed on appliances, many of which have been misdirected toward questionable orthodontic objectives. Decisions on objectives in a given case must be something apart from and not subordinate to the limitations of an appliance. Appliances are important only in so far as they implement treatment objectives. This more important area will be discussed in a second article.

Details of construction of the basic labio-loop-lingual appliance have already been presented[1] (Fig. 1). This is a dynamic three-dimensional appliance, effective and efficient. However, mastering the fine and delicate adjustments requires time-consuming study and practice in handling.

For each adjustment in the arch, compensating adjustments (sometimes as many as three or four) are required to retain neutral relationships in the balance of the arch. These must be understood and strictly adhered to or control is lost.

The securing of anchorage with the loop-lingual appliance is contingent upon the summation of contact resistances in the buccal segment and the anterior placement of the arch in contact with each tooth in the position indicated in Fig. 2. Incomplete adherence to this detail will result in proportionate loss of anchorage.

In cases where there is a labial axial inclination of the mandibular teeth prior to treatment, it is advisable that these be retracted and verticalized before the loop-lingual arch wire is secured for Class II traction.

Success or failure depends on (1) delicate appliance adjustments within the arch to prevent overriding the selected anchorage and (2) adequate case analysis in terms of sequence and critical timing of the arch adjustments.

Fig. 3, *A* and *B* shows a variation of a Class I case which is commonly called a pseudo Class III. Three mandibular incisors are displaced into labial

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occlusion and the maxillary right central and lateral incisors are slightly deflected lingually. The balance of the occlusion is normal. In this instance, the appliance was a lingual arch wire in which an anterior Hawley attachment of 0.022 inch thickness was used. As indicated in Fig. 3, *C*, 0.020 inch finger loops on the lingual arch wire engaging the mesial surface of each lower canine were activated on the first visit to carry the canines distally into contact. On the second visit a similar loop was applied to the mandibular left lateral in-

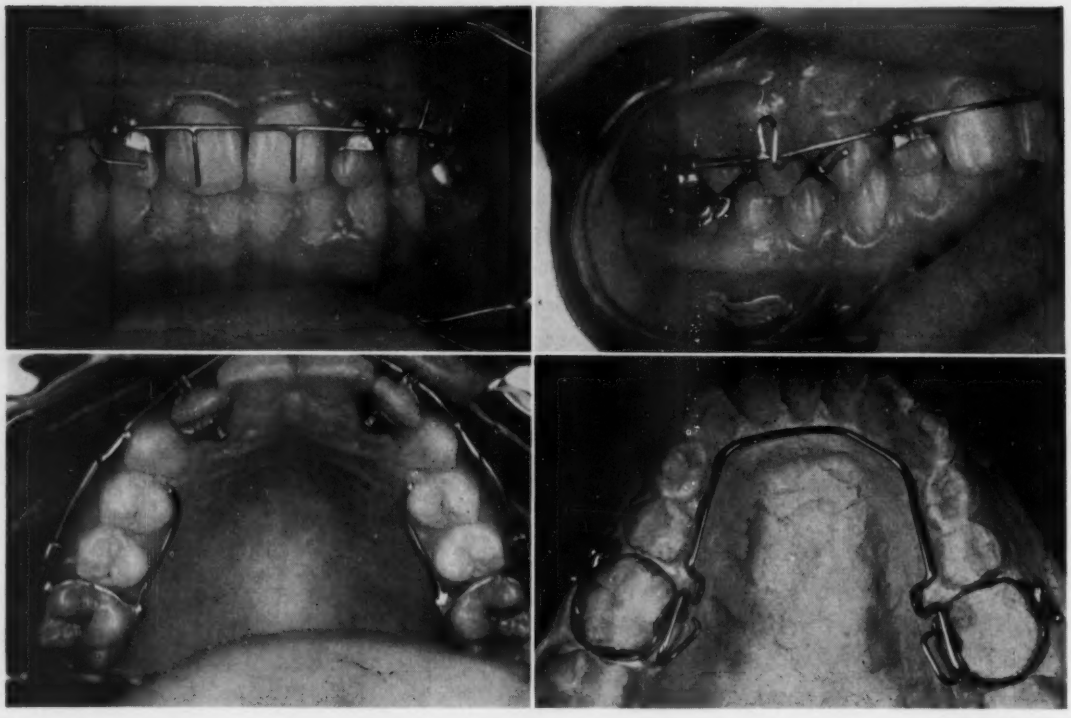

Fig. 1.

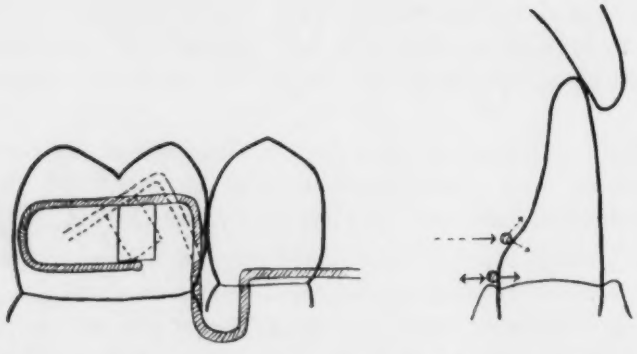

Fig. 2.—This diagram shows graphically the resolution on anterior forces with the loop-lingual appliance. The posterior segment shows the necessary wire parallelism of the molar and more anterior section as well as the half-round post-to-tube parallelism. The dotted sections show a common error in adjustment. Strict conformity to these principles of adjustment is a necessary key to successful use of the loop-lingual appliance. (From Wilson: AM. J. ORTHODONTICS, November, 1955.)

cisor to carry that distally also into contact. With the interferences now removed and the lingual arch wire having been originally designed to avoid interference, the anterior Hawley attachment is now activated on the third visit (Fig. 3, *D*) to carry the mandibular incisors lingually. On the fourth visit, as indicated in Fig. 3, *E* and *F*, the occlusion is corrected, with automatic compensating occlusal factors causing the maxillary teeth to assume their normal position. The same occlusal factors suffice for retention needs.

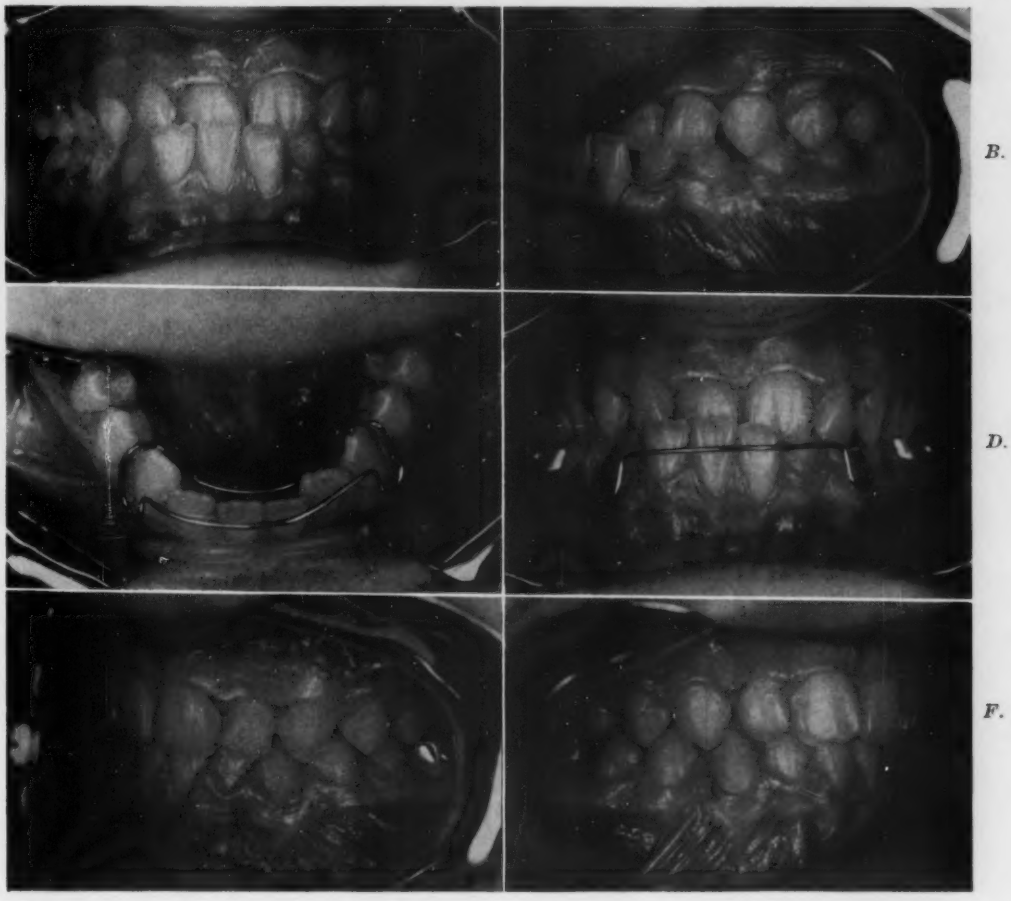

Fig. 3.

In contrast, Fig. 4, *A*, *B*, and *C* shows a bona fide Class III malocclusion with an under-development of the premaxilla. This case shows the procedure in Class III therapy and also demonstrates the analysis of arch requirements by quadrants. Fig. 4, *D* shows a mesial drift in the maxillary left quadrant and a mesial drift in the mandibular right quadrant. In each instance the positioning of the posterior teeth contraindicated distal movement of the molars. Extraction of the maxillary left fully rotated second premolar and the mandibular right first premolar was decided upon. In the maxilla a typical labial arch, as indicated in Fig. 1, was used to band the maxillary right lateral and

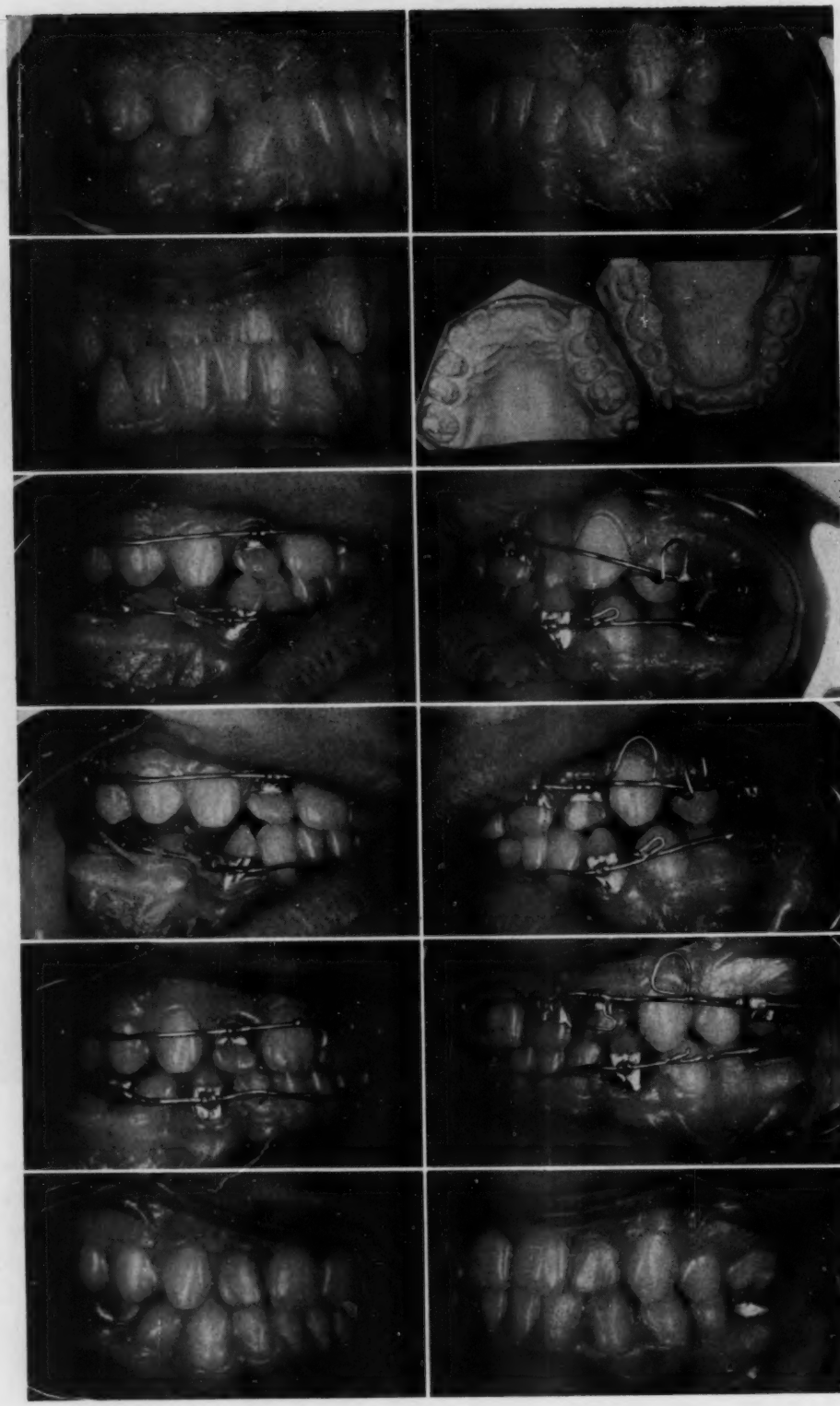

Fig. 4.

left central incisors. In the mandible the loop-lingual arch wire is not used in Class III cases; instead, a labial arch is used with the mandibular canines being banded.

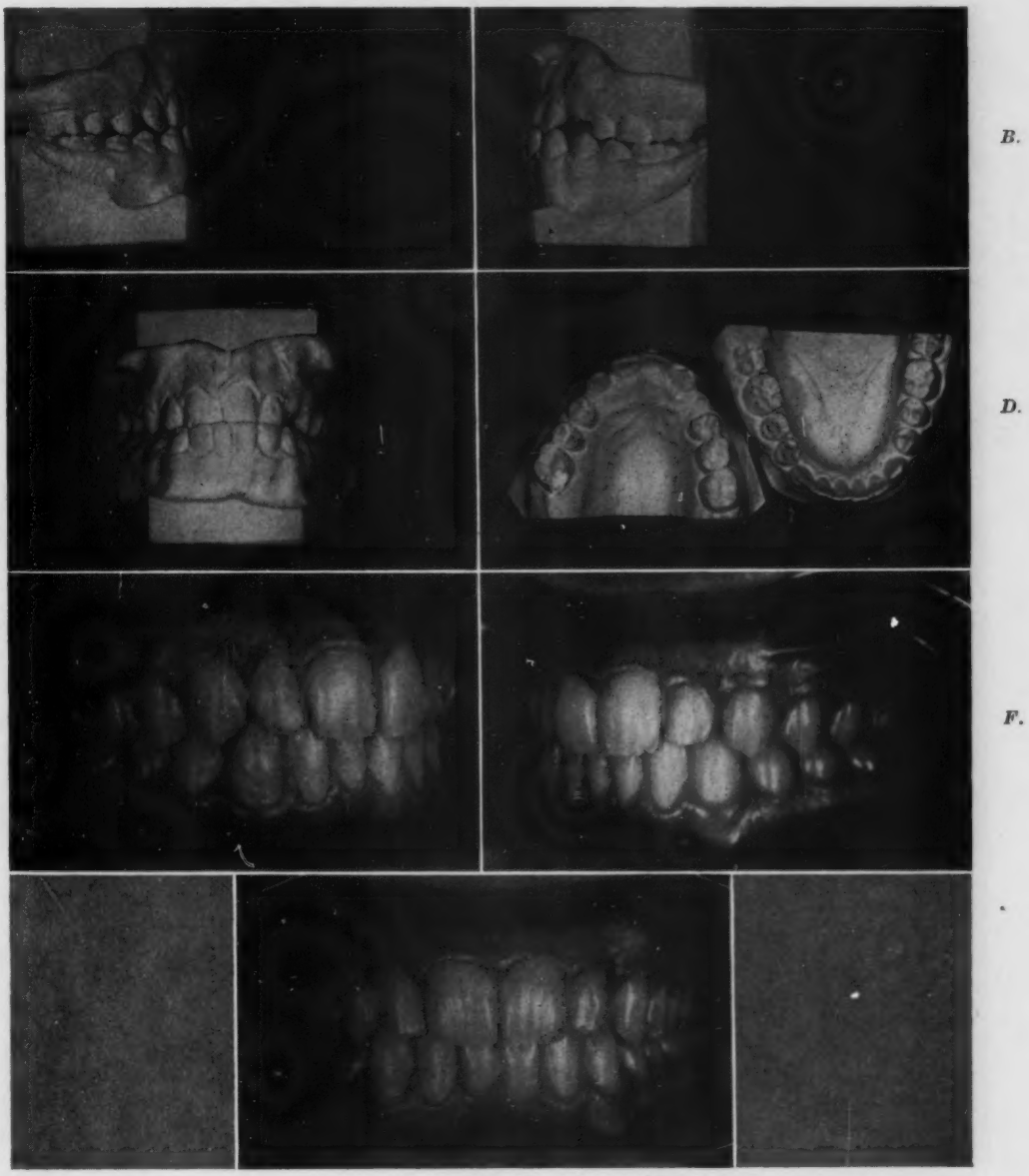

Fig. 5.

In this instance, we proceeded directly with Class III elastics coincident with the development of the premaxillary area through screw force on the maxillary labial arch. This is done coincidentally with distal movement of the mandibular canine in trolley fashion along the arch with shrinking ligatures. Fig. 4, *E*, *G*, and *I* shows progress in this direction. Similar Class III therapy

is carried out simultaneously on the left side. This is coincident with mesial movement of the molar (Fig. 4, *F*) through the use of the silk ligature and distal retraction of the first premolar with an 0.020 inch finger loop as indicated. Fig.

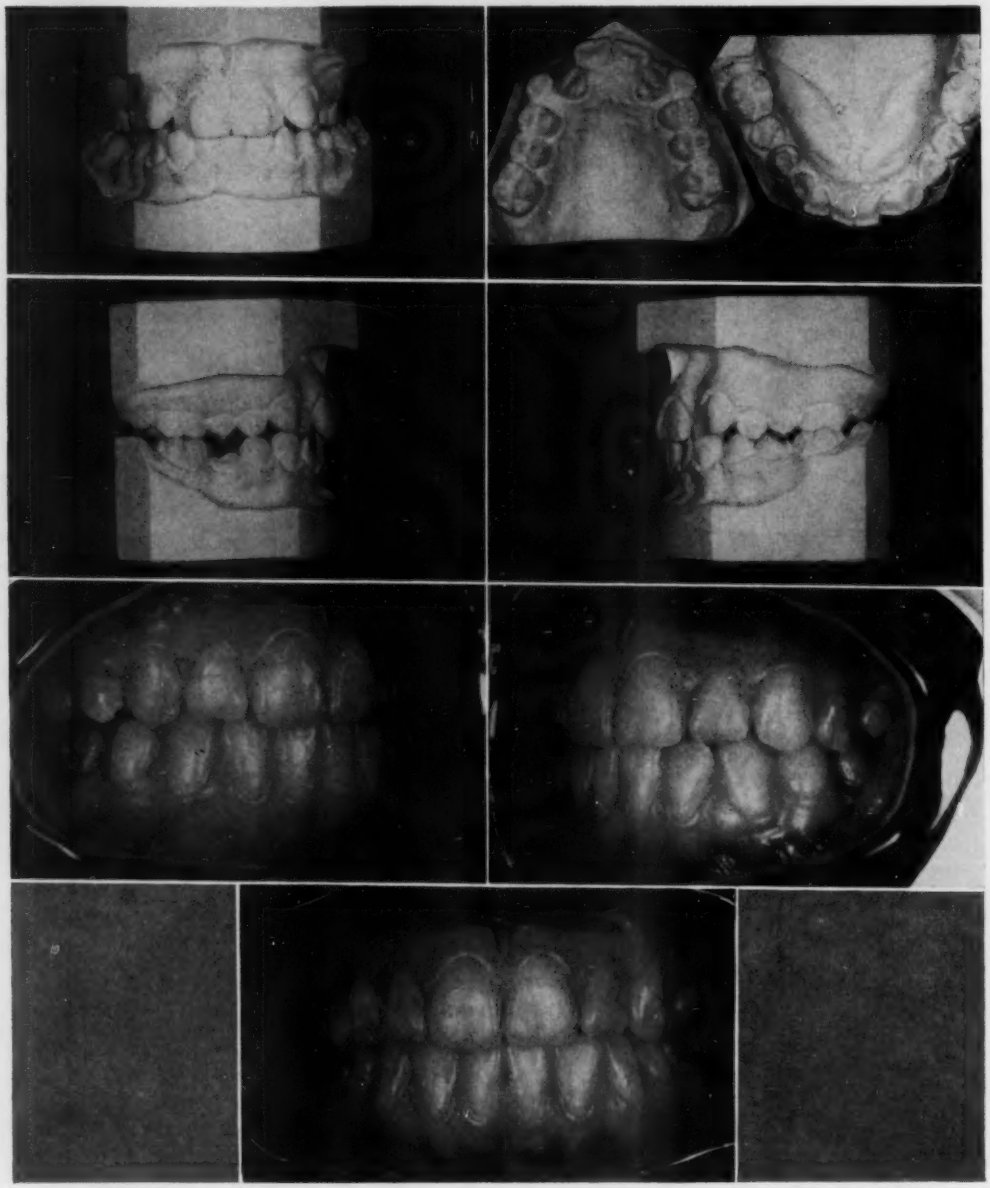

Fig. 6.

4, *H* shows the canine being retracted and the lateral incisor being engaged with the labial arch wire. Fig. 4, *I* shows the lateral incisor being carried forward into labial position and rotated with an 0.020 inch finger loop. Fig. 4, *J* shows the result at the end of ten months of treatment. After some settling, the

appliances were removed at twelve months and a Hawley retainer was placed on the maxillary arch. Fig. 4, *K* and *L* shows the case two years later.

Fig. 5, *A*, *B*, and *C* shows a Class III case in which there has been a mesial drift of the maxillary right buccal segment as indicated in Fig. 5, *D*, with the maxillary right canine being blocked out entirely. In this instance, a labio-loop-lingual setup for Class II therapy using the coiled-spring principle on the maxillary right side was used over a period of two months to carry the maxillary right buccal segments distally. At this point, the upper arch was stabilized and Class III traction was applied to a mandibular labial arch with canines banded. This was carried out in the same procedure as in Fig. 4. This case

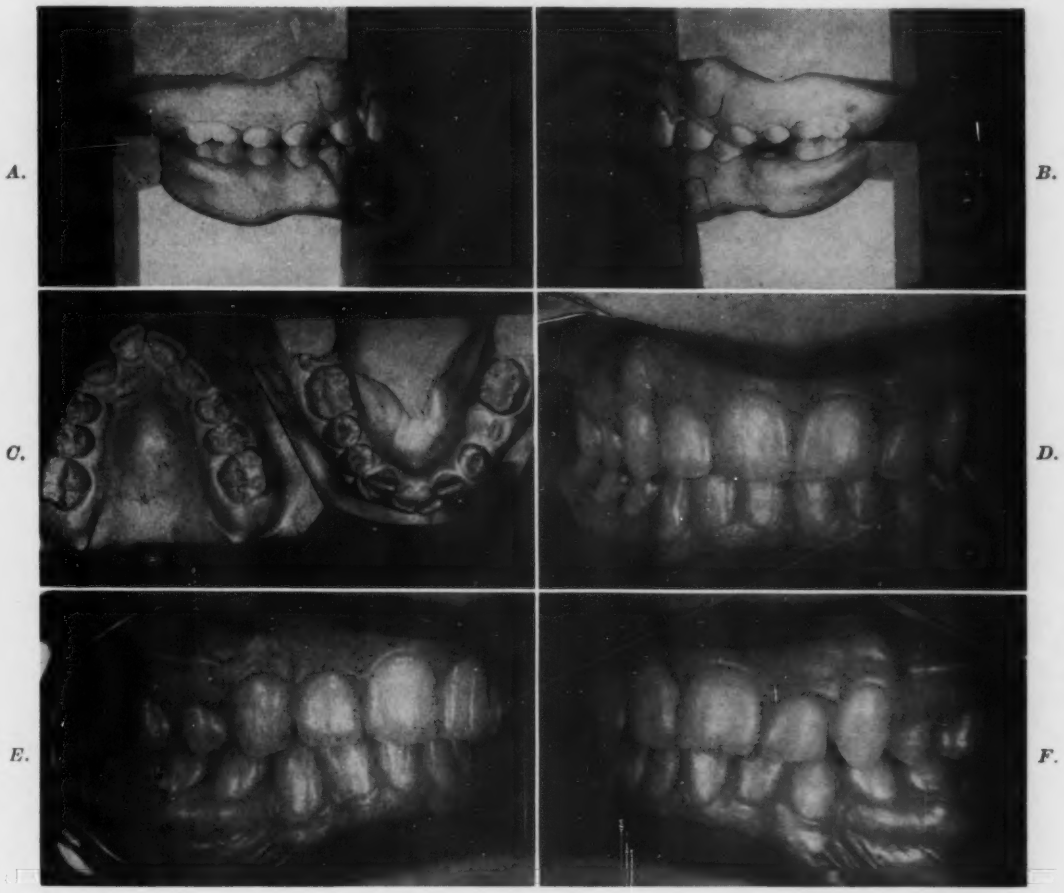

Fig. 7.

indicates the use of the loop-lingual arch wire in such instances without upsetting the mandibular anchorage. Treatment time was twenty months. Fig. 5, *E*, *F*, and *G* shows the case five years later.

Fig. 6 shows a Class I deficiency case with the anterior median line displaced. The maxillary first premolars and the mandibular second premolars

were removed, the latter being in infra and rotated position. In this instance, the mandibular loop-lingual arch wire was applied and the space was closed through control of the loop and the use of an 0.020 inch finger loop for distal movement of the first premolars, following with similar loops for distal movement of the canines. Finally an 0.022 inch anterior Hawley attachment, such as that used in Fig. 3, effected the lingual movement and control of the mandibular incisors. Coincidentally, the maxillary first molars and lateral incisors were banded for the labial arch and the spaces were closed through the use of finger loops and shrinking silk ligatures, as indicated in Fig. 4. Following this the incisors were aligned with a labial arch. Treatment time was twenty-two months. Fig. 6, *E, F,* and *G* shows the case five years after treatment.

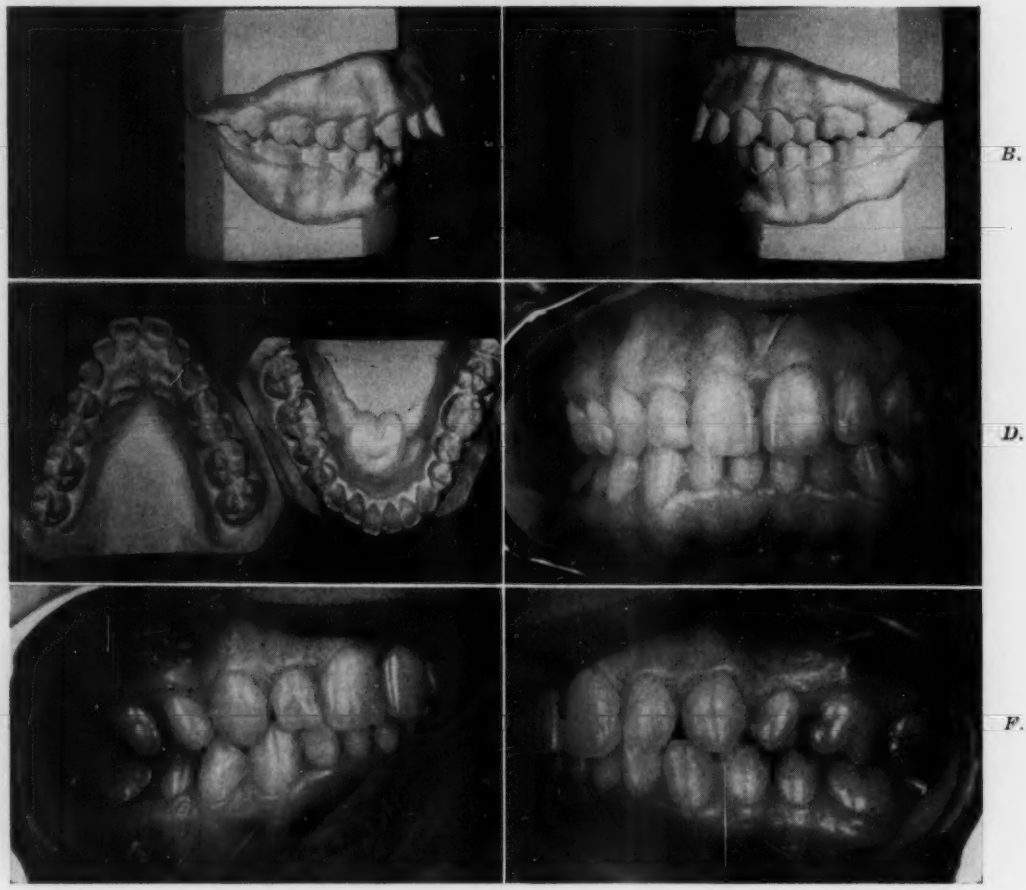

Fig. 8.

Fig. 7 shows another deficiency case in which four first premolars were removed. In this instance the spaces were closed with retracting loops, as indicated previously. Treatment time was two years. Fig. 7, *D, E,* and *F* shows the case four years after treatment. There is little evidence of tipping of crowns in the buccal segments. The fulcrum on which each of these teeth moves is contingent

upon the point of pressure application. Therefore, it is essential that the 0.020 inch finger loops be activated high, almost within the gingival crevice, to minimize tipping with distal and mesial movement.

Fig. 9.

Fig. 8 shows a Class II, Division 1 malocclusion in a patient aged 23 years. On the mandibular arch the loop-lingual appliance was used to widen the arch slightly and then was secured for intermaxillary traction. In the maxillary arch the first premolars were removed. The maxillary canines were banded, in addition to use of the classical appliance demonstrated, the canine bands

having intermaxillary hooks that engaged elastics at the distal lingual corner. These elastics were activated to the mandibular arch. The canines were then carried trolley fashion along the arch wire into position. Next, the four anterior teeth were retracted into position with elastic force on the arch wire. The total treatment was effected within twelve months' time and Fig. 8, *D*, *E*, and *F* shows the patient four years later, when a Hawley retainer was still being worn at night.

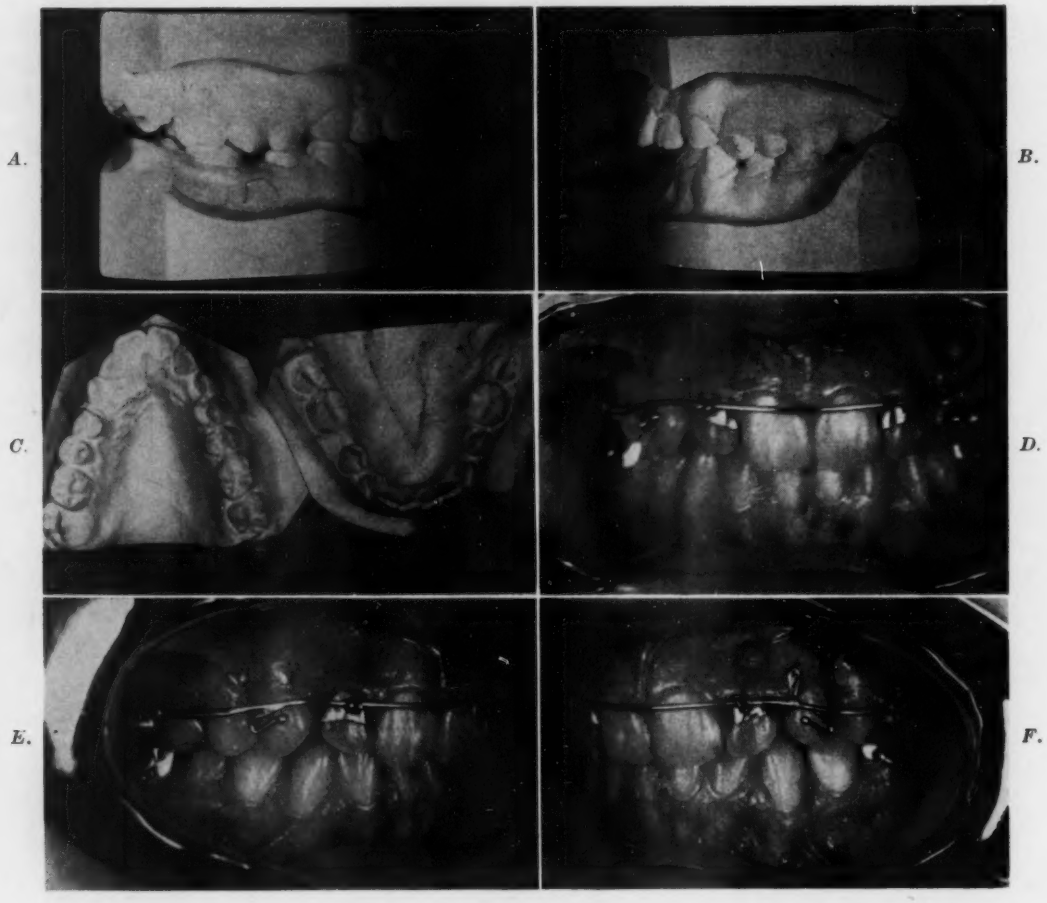

Fig. 10.

Fig. 9, *A*, *B*, *C*, and *D* shows a Class II case with mesial drift of buccal segments with maxillary molars being in buccal occlusion and heavily decalcified. In this instance, the x-ray film showed excellent-sized maxillary third molars and so the maxillary second molars were extracted. The lower loop-lingual arch wire was used to stabilize the lower arch and was secured for intermaxillary traction. The coiled-spring principle was used and activated against the molars and buccal segments to carry them distally. Coincident with this distal movement of the buccal segments, there was an automatic improvement in the anterior bite level, which is a primary objective in treatment.

Both mandibular central incisors were congenitally missing and the mandibular lateral incisors were large. In this instance, the lower arch was organized to supply one central incisor of the same size and shape as the other two incisors. Had all four mandibular incisors been present, the extraction of one central incisor here would have been indicated to achieve balance. It may be seen here, then, that the selection of a premolar or a second molar for extraction may be predicated in part upon the objectives concerning the anterior bite level.

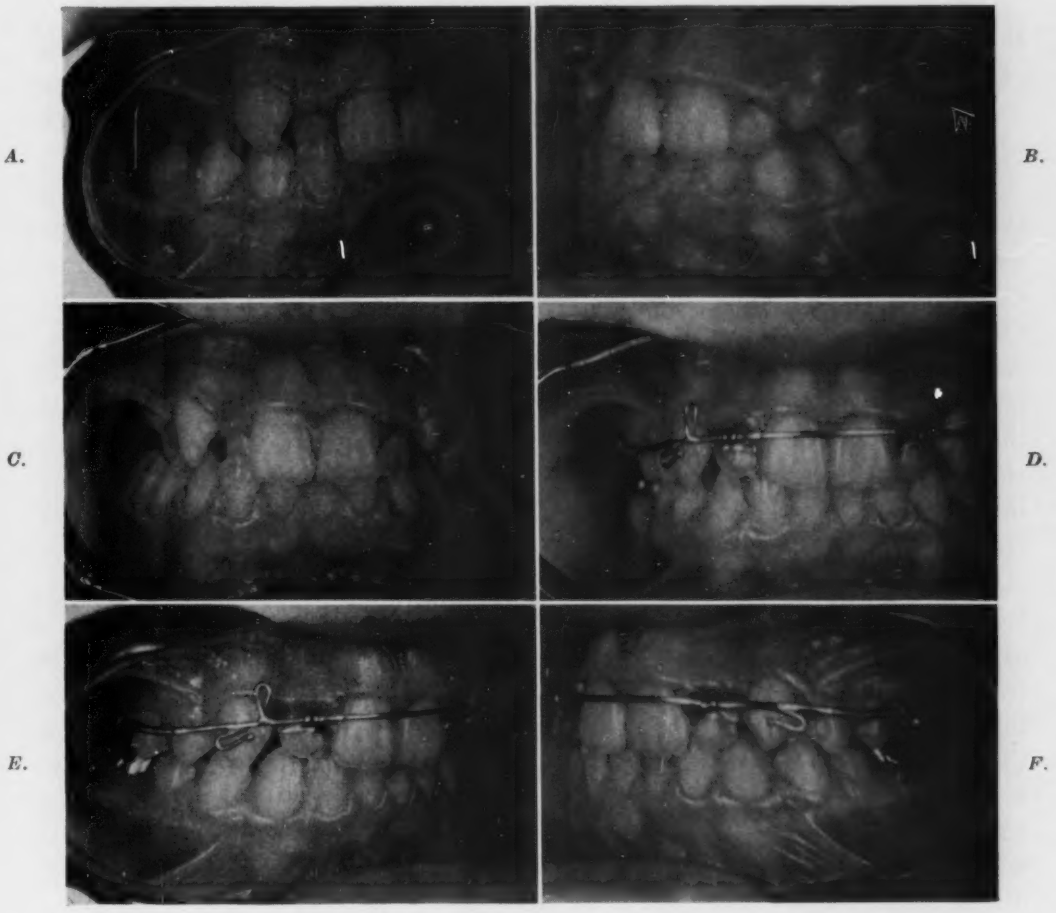

Fig. 11.

Fig. 10 shows a Class II case with mesial drift of the mandibular first molars; on the right side the second premolar is impacted and on the left side it is congenitally missing. In this case it was decided to increase the lower arch on the right side to contain the second premolar and on the maxillary left side to extract the maxillary first premolar to compensate for the missing premolar below. In this instance, then, we find ourselves developing the arches on one side of the mouth and extracting on the other. This once more stresses the value of quadrant analysis concerning arch requirements. In the mandible

the loop-lingual arch wire is used once more and, through control of the loop, the mandibular arch was developed as indicated previously. Also through the control of the loop on the left side and the use of intermaxillary traction, the molar and premolar were brought forward to close the existing space. In the maxilla the spaces were closed on the left side through the use of the finger loop, once more supplemented by intermaxillary traction. The maxillary incisors were aligned by gentle arch pressure. Treatment time was eighteen months.

In the cases just demonstrated, I have shown seven different approaches to the extraction problem, each one being predicated upon the clinical assessment of the case and evaluated in terms of the objectives.

In the next group of deficiency cases, I shall discuss the use of the appliance without extractions.

Fig. 11 shows a Class I case with a gross underdevelopment of the maxilla; the mandibular arch is almost normal. In this instance, the loop-lingual arch wire is used on the mandibular arch and the upper labial arch is used with the expansion principle being effected through the use of palatal arms to correct the maxillary right side. In this instance, expansion of the arch is supplemented by a directional insertion of the arch into the buccal tube to effect palatal-arm pressure on the premolars. With the premolars in position, then, the 0.020 inch finger loop is used to retract the canine into position. This, reciprocally acting upon the arch wire, is now adjusted into the Howe lock on the lateral incisor and reciprocal pressures align the anterior teeth. Fig. 11, *D*, *E*, and *F* shows the case after eight months of treatment.

Fig. 12 shows a Class I case in which there is a mesial drift of the maxillary left segment and the maxillary left lateral incisor is in lingual occlusion. The other maxillary incisors are labially displaced and the anterior bite is closed. In this instance, the lower arch is shaped with the loop-lingual arch wire and the coiled-spring principle is used to retract the maxillary left segment into Class I relationship, following which (Fig. 11) the maxillary left lateral incisor is brought into position by contouring the labial arch through the Howe lock. The maxillary incisors are rounded off in the final stage with the labial arch wire. A significant improvement in the anterior bite level is noted with the distal movement of the maxillary buccal segments. Fig. 12, *D*, *E*, and *F* shows the patient after eighteen months of treatment.

Fig. 13 shows another deficiency case in which the maxillary arch was increased in both a distal and a labial direction through the use of the coiled-spring principle supplemented by intermaxillary elastics. Initially the maxillary central incisors were banded and the coiled-spring application was against the molars in a distal direction. Fig. 13, *E* shows the premolar carried back distally through the use of the finger loop, this being followed with a canine which has now been retracted into position. Fig. 13, *D* shows the coiled spring being activated on the left side. Fig. 13, *F* shows the premolars being carried

distally into position and the canine erupting into place. Fig. 13, *G* and *H* shows the alignment of the anterior teeth and the desired anterior bite opening which is coincident with the posterior movement of the maxillary buccal segments.

A question arises as to the validity of this method in moving maxillary buccal segments distally. Fig. 14 shows a follow-up of a case presented some two years ago in which similar distal buccal movement was effected. Fig. 14, *G, H,* and *I* shows that the occlusion now reflects stability and Fig. 14, *J* indicates that the mandibular arch has not suffered any ill effects from extensive intermaxillary traction. The mandibular lingual arch wire now has been removed

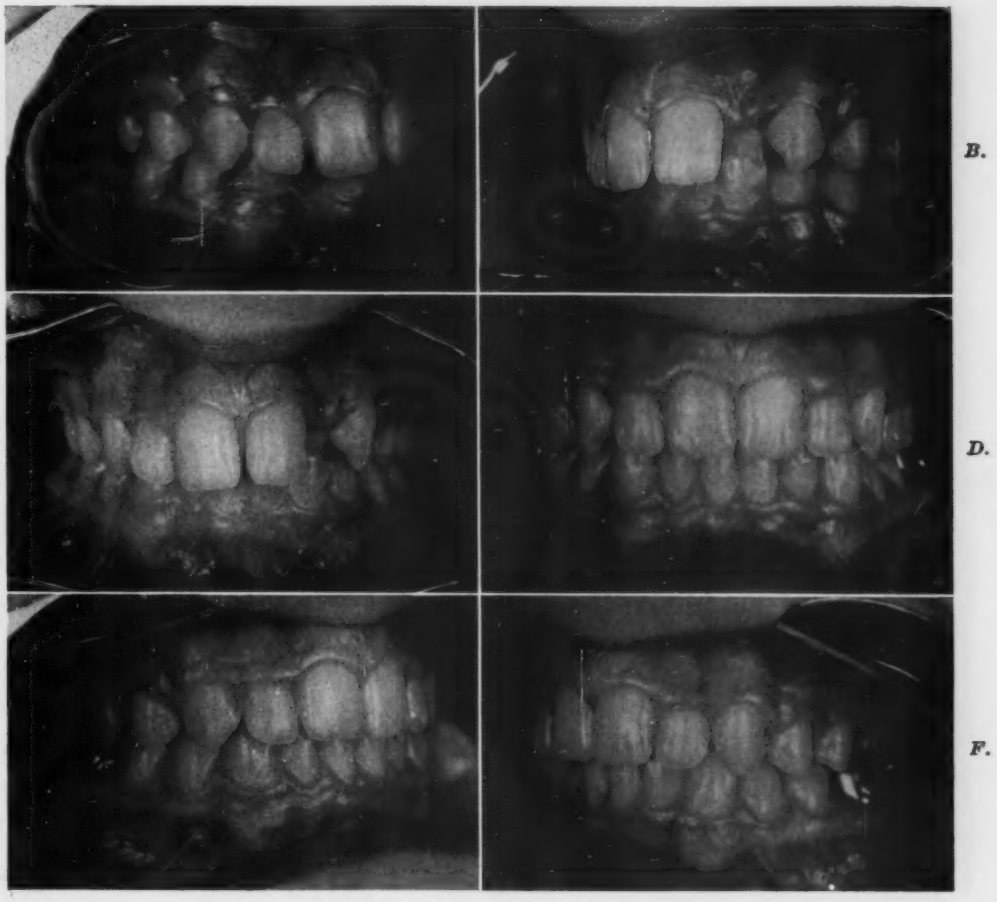

Fig. 12.

for a year. Interestingly too, the four third molars are now erupted and are in functional position. In some instances, however, where this distal movement is effected, it is done with the calculated intent of sacrificing third molars.

Fig. 15 shows a deficiency case in which the arches were increased, both in the anteroposterior dimension and through buccal expansion. Fig. 15, *B, D,*

and *F* shows the case following treatment with posterior occlusion corrected and the anterior bite level improved. Fig. 15, *H*, *I*, and *J* shows the case five years out of retention.

Fig. 13.

Fig. 16, *A* and *B* shows an extremely narrow Class I case. Here the arches were expanded with the labio-loop-lingual appliance, using the effective palatal arms on the maxillary arch. With this expansion, there was a slight bite opening in the buccal segments and this was held until the teeth settled into position as shown in Fig. 16, *G* and *H*. Fig. 16, *I* shows the maxillary arch at the

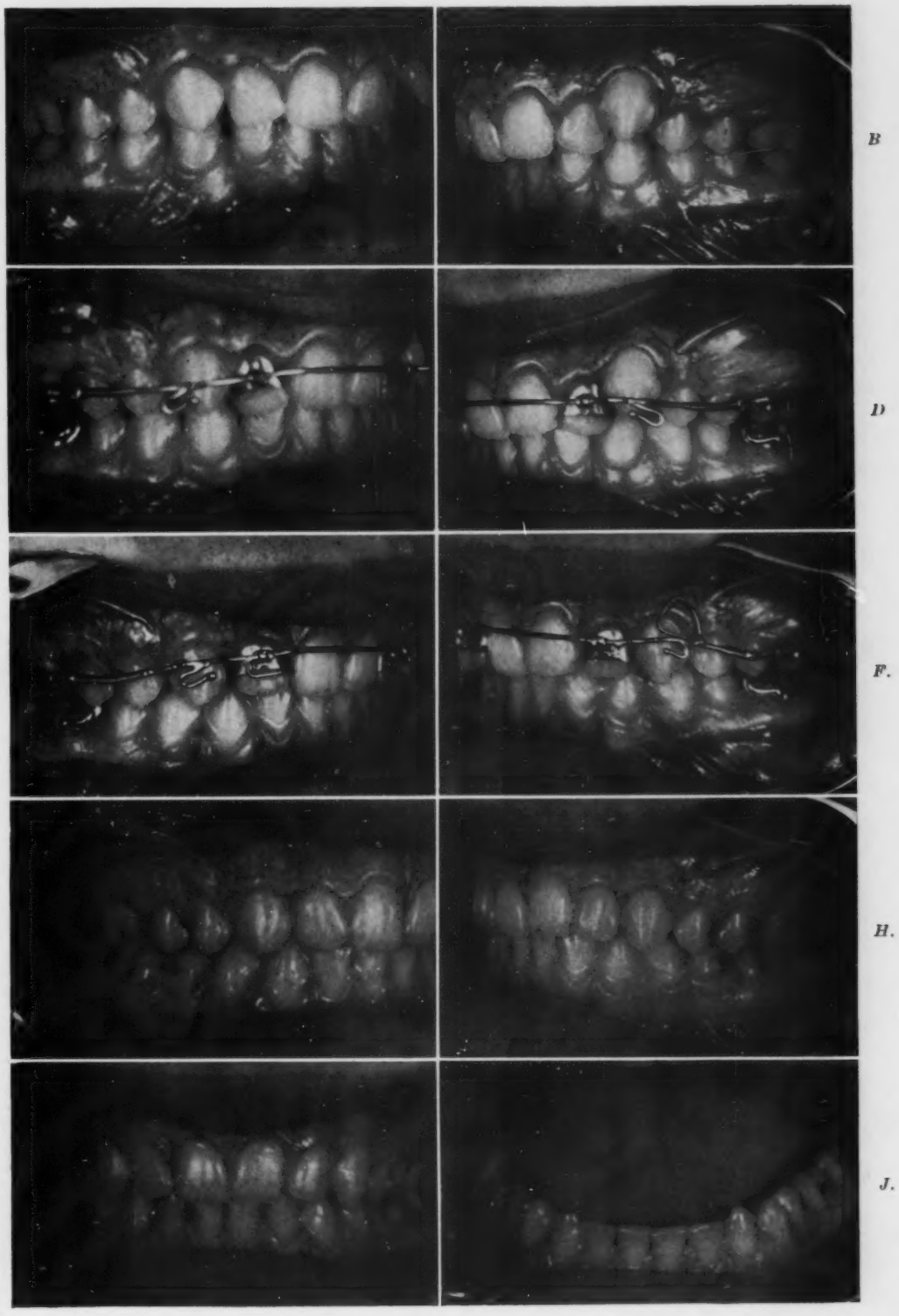

Fig. 14.

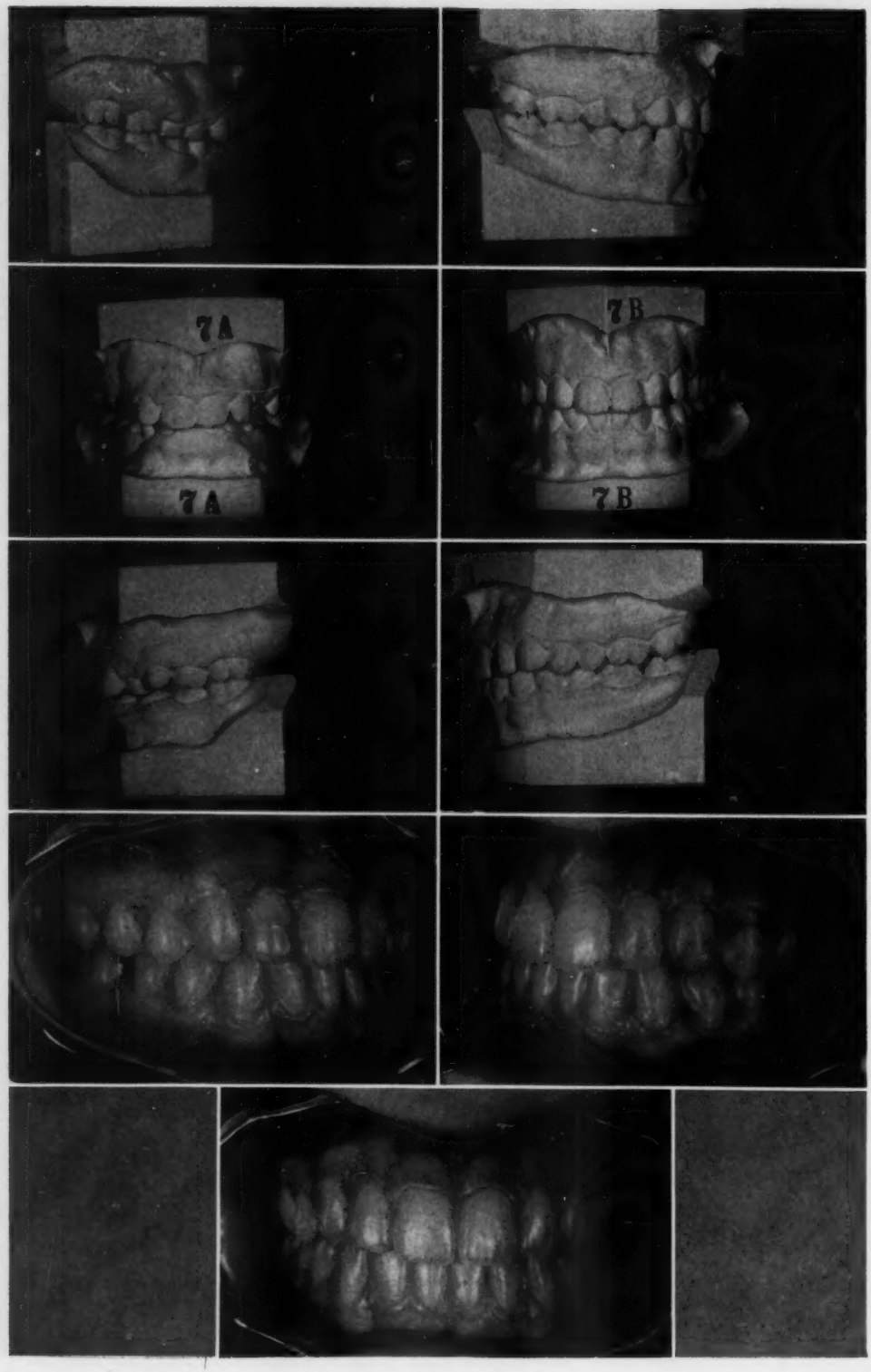

Fig. 15.

Fig. 16.

time that retention was dropped. From an occlusal view, it will be noted that one can see the gingival borders of the premolar teeth, which indicates that the axial inclination of the premolars is a favorable one. In consideration of the

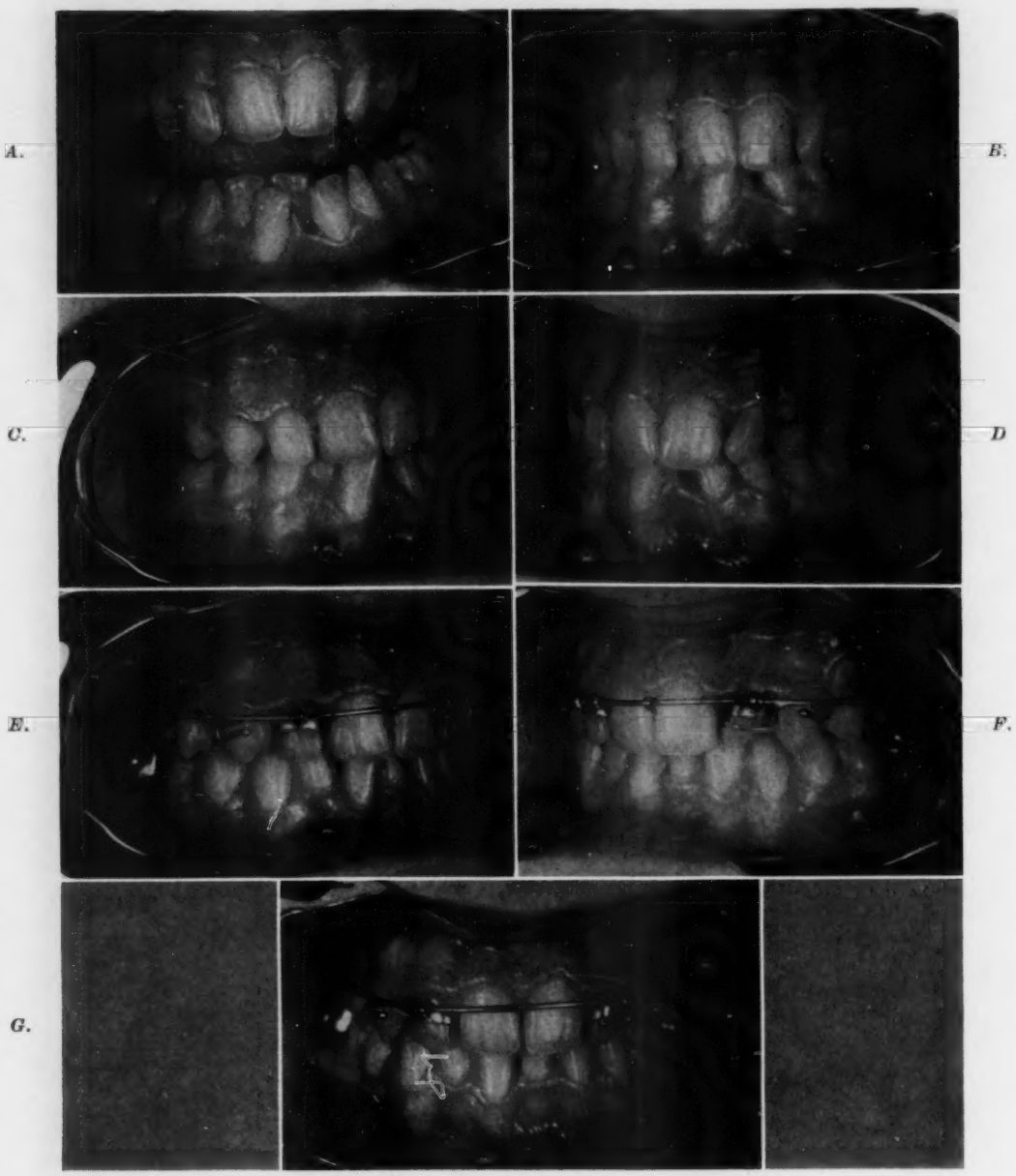

Fig. 17.

extreme amount of expansion achieved in this case, it was expected that there might be a degree of relapse. Fig. 16, *J* shows a loss of 2 mm. in buccal width three and one-half years later. This is significant but minimal. The posterior

occlusion remains satisfactory and the facial esthetics adequate. The arches have now reached a stable position and have retained 8 mm. of expansion in the first premolar area.

The approach to deficiency in mandibular arch canine width is a problem which may be dealt with in various ways with varying degrees of stability. Some cases can tolerate no increase in canine width whatsoever, while others will tolerate a degree with reasonable stability if retained well. There is another group in which the deficiency in canine width results from mesial positioning of the canine into a narrower part of the arch. This may result from mesial drifting of the buccal segments; it also may represent a local manifestation of a transitional problem. In Fig. 17 such a case is evident. In this instance, the lower loop-lingual arch wire is placed coincident with the extraction of the second deciduous molars. The first molars are retained into position and with the finger loops, as already discussed, the premolars and canines are carried distally into a wider part of the arch. This permits a generous and an excessive amount of spacing which allows the lower incisors to be aligned into more favorable position, as indicated in Fig. 17, *E, F,* and *G.* Coincidentally the maxillary arch is being regulated with the labial arch as indicated previously.

Fig. 18, *A* shows a similar case with a deficiency in the mandibular anterior region which was treated in the same manner. Here the lower molars were moved distally slightly; the premolars also were carried distally into a wider part of the arch and expanded slightly. This was followed by canine retraction and incisor alignment. Coincidentally with this, impacted palatal canines were exposed and then, with intermaxillary traction and coiled-spring principle, the maxillary buccal segments were carried distally to make room for the canines. The canines then were brought through the spaces into position. Corollary to this treatment, the anterior bite level improved; the occlusion was retained for three years and Fig. 18, *E, F,* and *G* shows the patient four years out of retention. Aside from minor settling in the mandibular lateral incisors, the case has been retained in functional balance.

Fig. 19, *A, B, C,* and *D* shows another Class I deficiency case with a close-bite. In this instance, as indicated in Fig. 19, *E, F,* and *G,* the classical labio-loop-lingual appliance was used to increase both arches in an anteroposterior direction with slight buccal expansion. Fig. 19, *H, I,* and *J* shows the patient four years after treatment. Interestingly, in spite of the considerable increase in arch size in an anterior as well as in a buccal direction, the profile photographs of the patient before and after treatment show a reduction in the lower facial third.

Fig. 20 shows a Class I case with an anterior close-bite resulting from a lingual drift of the mandibular incisors which perhaps was aided by the premature loss of a mandibular right deciduous canine. In this instance, the space for the mandibular canine is almost closed. A classical labio-loop-lingual appliance was used and the lower arch length increased. The maxillary

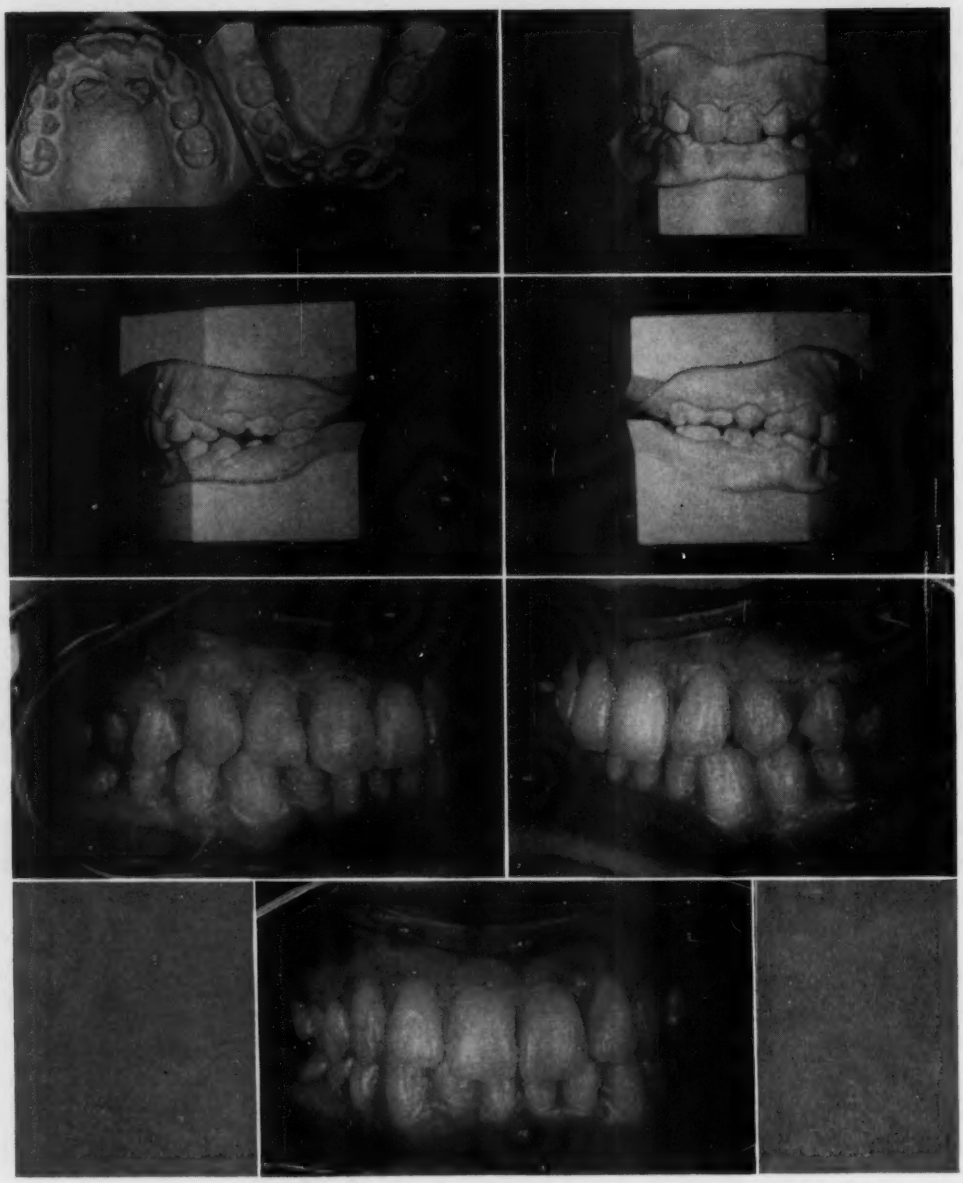

Fig. 18.

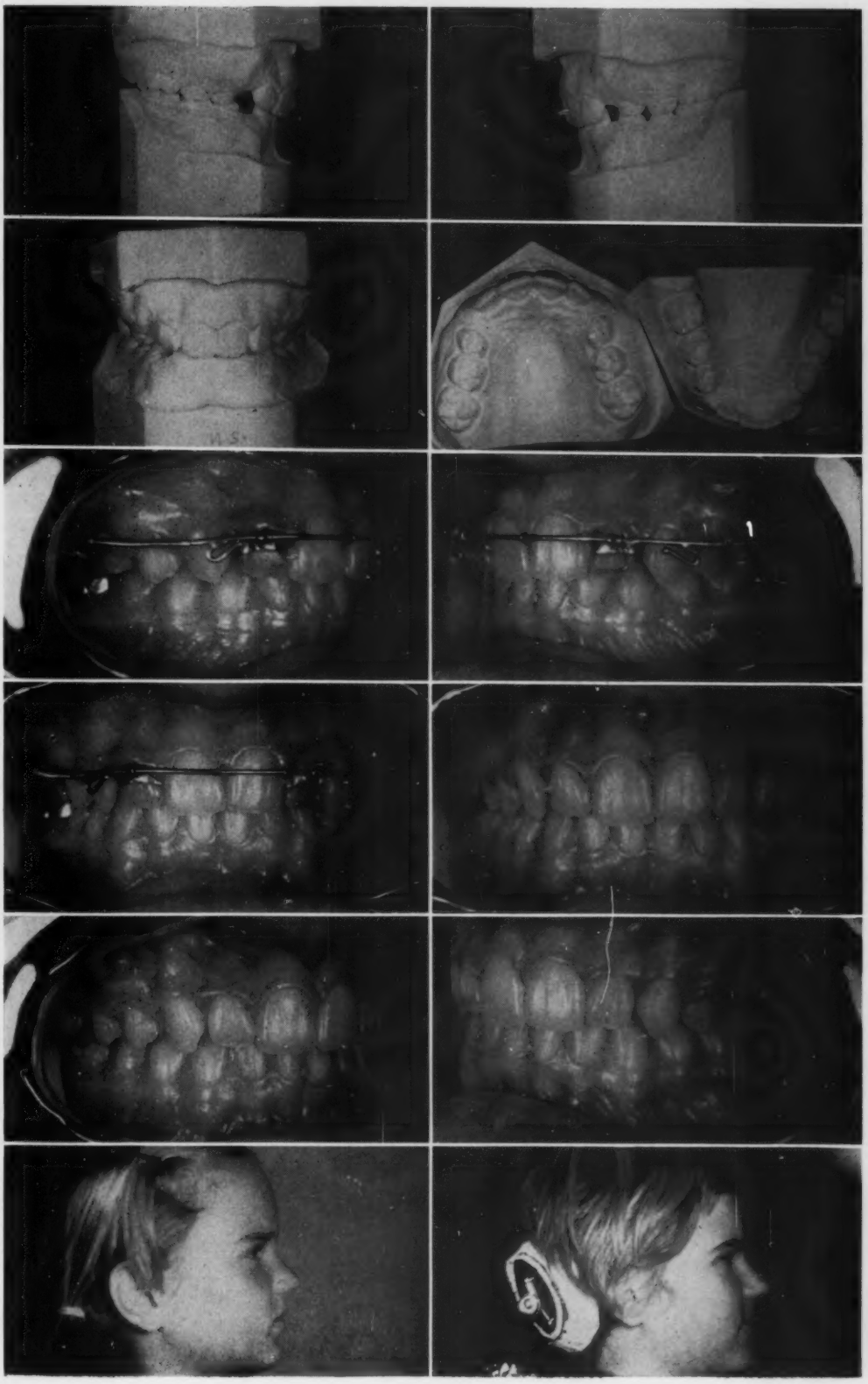

Fig. 19.

labial arch was used to retract the first premolars following extraction of the second deciduous molars, thus providing room for canine eruption. This, in turn, was followed by alignment of the six anterior teeth as shown in Fig. 20, *D* and *E*.

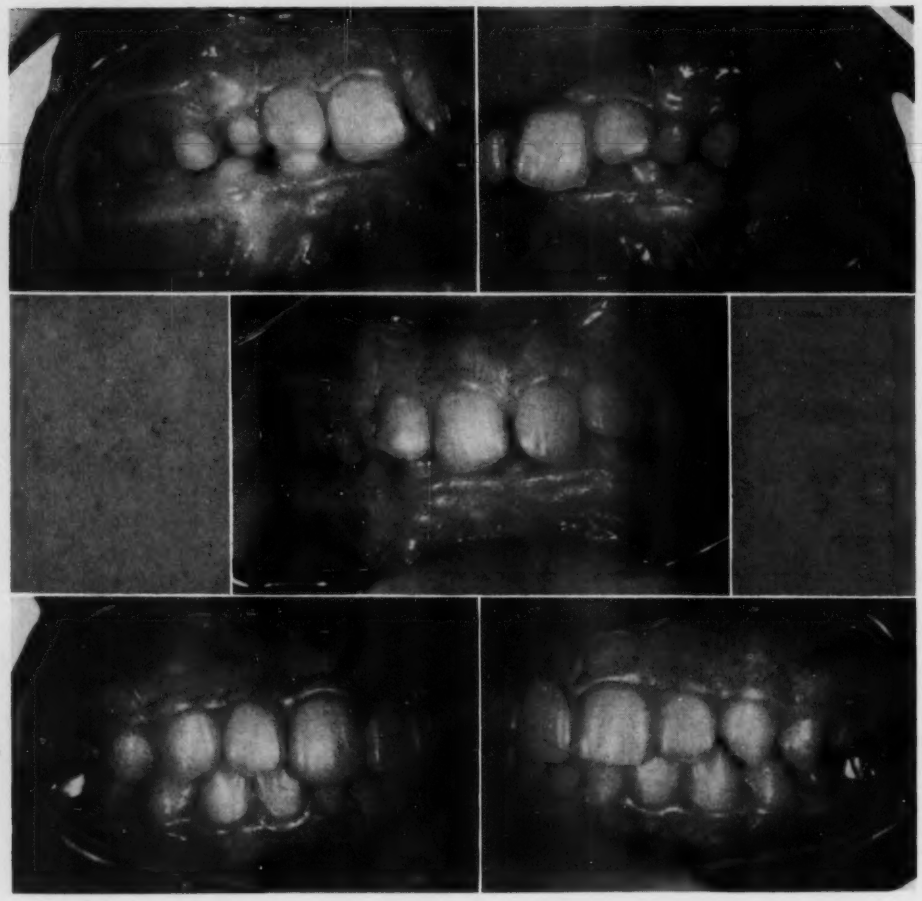

Fig. 20.

Fig. 21, *A* and *B* shows another Class I case in which there was lack of arch width, as well as an anterior close-bite and apparent lack of supporting bone over the incisor teeth causing them to have a labial inclination. In this instance the classical labio-loop-lingual appliance was used. The second deciduous molars were extracted and the premolars were guided into place as they erupted. This was followed by expansion and alignment of the anterior teeth. Fig. 21, *C, D,* and *E* shows the patient three years out of retention.

Fig. 22 shows posttreatment photographs of a patient who had an extreme Class II, Division 1 malocclusion with narrow arches and a close-bite. This patient was treated for fifteen months with the classical labio-loop-lingual appliance, and a Hawley retainer was placed in June, 1936. In 1937 the patient

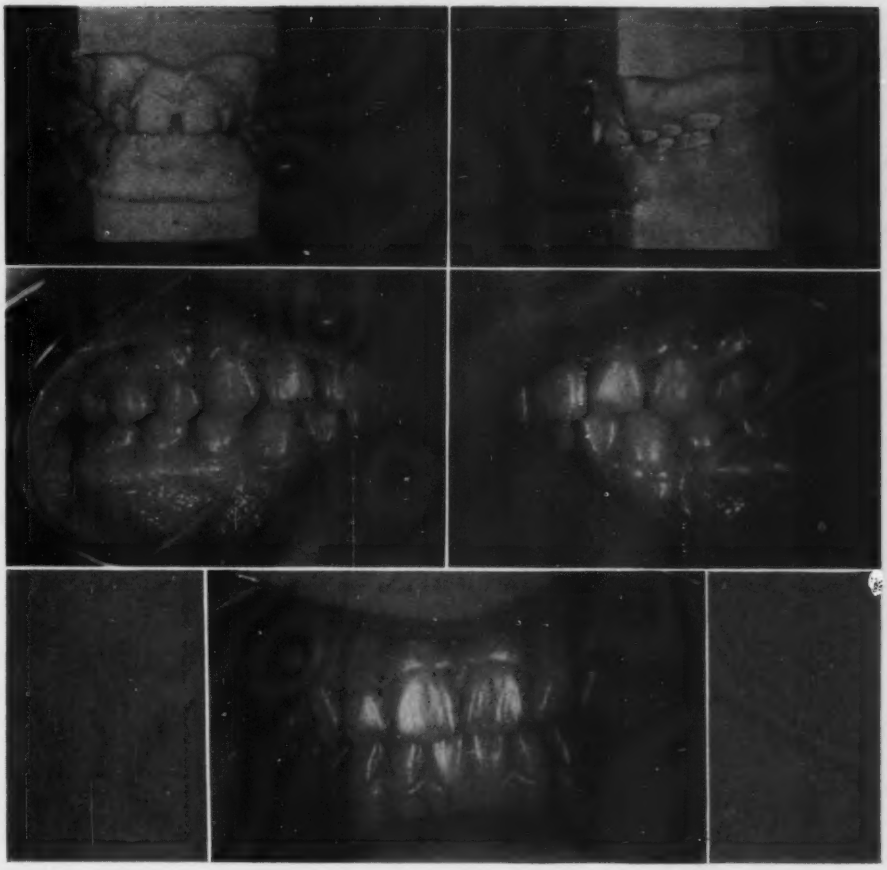

Fig. 21.

Fig. 22.

showed a relapse on the left side in a distal direction. In this instance, the mandibular left first premolar was banded with an inclined plane to engage the mesial aspect of the maxillary first premolar, and this appliance was worn for two years. The patient was not seen again until recently and the photographs show the results twenty years after treatment. This is interesting for many reasons. The Class II deformity has been corrected and has remained stable. The initial Class II relapse on the left side has been secured by an additional two years of retention. The expansion has not relapsed and, twenty years after extensive Class II elastic traction with the mandibular loop-lingual appliance, mandibular incisor collapse has yet to occur. There is one factor to sober any enthusiasm about this result, namely, the unfavorable anterior closed-bite. This is the trend of occlusal dynamics with increasing age. It is commonly ignored by the orthodontist and yet its consideration must not be overlooked in treatment planning.

Each of the cases just presented has been selected for a specific purpose. The multiple usage of the labio-loop-lingual appliance here has been demonstrated in a variety of cases where different types of arch increase have been indicated and in extraction cases where a number of different approaches to the extraction problem have been used. It should be clear, then, that treatment planning in these cases is not predicated upon the limitations of the appliance. Perhaps more important has been the demonstrated consideration of occlusal dynamics.

In medicine it is axiomatic for one to think of infections in terms of two factors: (1) the virulence of the organism and (2) the reaction of the host or the patient. Likewise, in therapy one considers the potency of the drug and the variations in response of the individual patient. More recently, in orthodontics we have come to think of treatment in terms of a mechanical approach to a mechanical problem. This is an error, for we must likewise think of orthodontics in terms of two factors: (1) the power and adaptability of the appliance and (2) the response or reaction within the dental arches. There are certain occlusal dynamic changes which occur when arches are expanded and arch relationships are changed. There are other dynamic occlusal changes which occur when teeth are extracted, depending upon the nature of the contiguous factors as well as the selection of critical teeth. This is not another orthodontic dogma; it is clearly a demonstrable dental fact. One can observe this in nonorthodontic cases in which critical teeth are extracted for dental reasons.

These dynamics are not observable when a multibanded technique is used because here the changes, whether desirable or not, are aborted. This is temporary, however, as the changes are part and parcel of Nature's readjustment after removal of the appliance. These changes are not to be divorced from the problem of relapse. With the use of the labio-loop-lingual appliance, one can see for himself these responses and the variations in arch changes. The orthodontist is free to control and exploit these to his advantage.

If there is a rule in orthodontics, it is that for every law, rule, or statement one can inevitably demonstrate an exception. Some of these exceptions, however, prove the rule and should not confuse us in our consideration of orthodontic phenomena. With few exceptions, the calculated occlusal dynamics in treatment follow similar patterns and, clinically at least, they are observable in the anterior bite level. This is something apart from the matter of intrusion or extrusion of anterior teeth. It is directly associated with changes in posterior dental vertical dimension and anterior changes in the incisal-occlusal plane relationship resulting from changes in axial inclination of teeth.

One can ordinarily anticipate an anterior bite opening with the following orthodontic procedures:

1. Expansion of the arch.
2. Distal movement of the maxillary buccal segments.
3. Labial movement of the incisors.
4. Class II mandibular changes.

One can generally expect an anterior bite closing with the following procedures:

1. Arch contraction. This is greater with the mesial movement of the posterior teeth and with lingual retraction of the incisors. The contraction of the buccal segments produces a significant but smaller amount of closure.
2. Extraction of teeth mesial to the first molars. There is a significant amount of anterior bite closing with the extraction of maxillary first or second premolars. The extraction of corresponding teeth in the mandible may produce a much larger amount of bite closure and this is in direct proportion to the amount of space to be closed. In severe deficiency cases where the amount of space closure is slight, there may be but little bite closure. Extraction of teeth distal to the first molars has no significant effect upon the bite level.

In certain cases, it is possible to utilize the counteracting or neutralizing effect of these dynamics. In Class II extraction cases, one might anticipate an increment of vertical loss from the extractions and at the same time an increment of vertical gain from the Class II changes. The degree must be evaluated in the individual case. Local factors, such as a tongue-thrust, may affect the changes quantitatively.

One might define occlusal dynamics as those changes resulting from the interaction of certain local factors which affect the supportive nature of contiguous teeth in the dentition, altering the functional stress and affecting the structural balance, the degree of which is qualified by the osseous and muscular scaffolding of the denture.

It becomes obvious that, while we achieve our results through mechanical means, ours is a biologic problem. When treatment planning runs counter to these trends of occlusal dynamics, failure will follow. The converse is true.

This is something which is independent of any type of appliance. One might refute this and attempt to expand arches with an edge-to-edge or opened bite. Here a further increment in bite opening becomes an obstinate problem, almost impossible to correct. On the other hand, in certain close-bite cases with reasonably good mandibular arches, when lower premolars are removed simultaneous space closure and improvement of the bite level is a long and difficult procedure and, upon removal of appliances, the high incidence of relapse and anterior bite closure is nothing more than occlusal dynamics at work. Orthodontic mechanical treatment, then, must be directed toward the objectives in the individual case which are qualified by the calculated directional trends in occlusal dynamics.

As we know, there are many different types of Class II, Division 1 cases and there are different methods of defining them. They must be approached in distinctly different ways because of the calculated occlusal dynamics which enhance or limit orthodontic results, depending on choice of treatment approach.

Some Class II cases require simple retraction of maxillary anterior teeth which are spaced along with slight maxillary expansion to permit the mandible to come forward. Still others may need distal movement of the maxillary buccal segments. This helps to improve the relationship and produces arch width which is often adequate. If more arch width is needed, buccal expansion follows the distal movement. This sequence is important. It permits the premolars to be carried distally through medullary bone. After expansion, distal movement through cortical bone is slow and difficult.

In Class II cases with close-bite, distal movement of maxillary first molars immediately opens the bite and removes occlusal interference in the buccal segments, permitting Class II changes. This accounts for the successful Class II therapy, with the use of a headcap, on maxillary first molars. It is almost axiomatic that with Class II changes one can expect a degree of bite opening. This is desirable in close-bite cases.

In open-bite Class II cases, one must consider this and use compensatory bite-closing factors, such as extraction procedures. If there is a deficiency in both arches, four premolars might then be removed. We have a surprisingly good number of mandibular arches in Class II cases, some of which have serious maxillary arch deficiencies. There is no need, then, to inflict extraction unnecessarily on the mandible when the deficiency is in the maxilla, because under these conditions lower spaces are difficult to close and nearly impossible to retain. They contribute a high degree of bite closure which cannot be easily corrected and retained.

In open-bite cases where the mandibular arch is adequate, one should consider the removal of maxillary premolars, retracting the maxillary anterior teeth, and leaving the first molars in mesial functional position.

On the other hand, there are some Class II cases with close-bites where arch requirements demand extraction in the upper arch. Here the maxillary third molars might be removed and the second and first molars carried distally.

If, perchance, the maxillary second molars are carious and the unerupted third molars are in good position, extraction of the second molar and distal movement of the first molar with subsequent distal movement of the buccal segments will open the bite and correct the relationship and the deficiency at the same time.

Class II, Division 2 cases generally need axial correction of intruded maxillary incisors. With this restrictive influence removed, mandibular arch relationship changes are generally rapid. Common to these cases is an excessive close-bite which improves with such treatment, sometimes requiring the assistance of a bite plane. Extractions are rarely required in Class II, Division 2 cases. In the face of the bite level factor, the hazards of extractions might very well be unsurmountable.

In Class III cases of known genetic origin, one must recognize the difficulties of treatment and retention; this applies also to those cases with obtuse gonial angles or anterior open-bites. These show a high degree of correlation. Class III cases with anterior close-bite and with anterior underdevelopment of the maxilla respond more favorably and have a higher retention index. Extraction may be determined by the individual quadrant analysis. Class III therapy is successful when local factors are causative and fails when etiological factors continue to be operative.

Most Class I cases can be categorized as follows:

1. Those in which adequate arch length permits arrangement of teeth without significant arch changes.
2. Those in which arch deficiencies can be dealt with by expansion or anteroposterior changes within the arch.
3. Those in which extraction is a made-to-order solution.
4. Those in which the approach in the second and third categories is not completely satisfactory and the advantages of each must be weighed against the inherent disadvantages.
5. Rarely discussed but not uncommon are the large arches with the small teeth being spaced. These are perhaps the most difficult of all to manage and to retain.
6. The multiple possibilities of midline discrepancies which must be analyzed in terms of local arch causes, facial asymmetry, contributing factors, and functional closure factors. Here the treatment is deployed against the etiological factor involved.

In Class I cases, as in all others, trends in occlusal dynamics are basic in consideration of treatment planning.

When, in the process of treatment, one sees indications of spontaneous self-improvement, however slight, indeed one's treatment planning is vindicated. I believe that it is not too far wrong to say that one's orthodontic treatment planning may be judged on the basis of the ease or difficulty with which he obtains his objective.

In orthodontic treatment, there is no factor more important than the timing of intervention. Certainly, this varies with the individual case. Early treatment is important, but I do not believe that one is always justified in starting treatment as soon as the malocclusion manifests itself unless, perchance, it is the type that will continue to become worse if not intercepted. There are many malocclusions which are slight and remain so and can be dealt with rather simply and quickly at a later age. In treating cases in the transitional dentition, we must recognize that there are some increments of growth occurring during treatment. These must be anticipated in direction with the degree to be determined. One learns that there are certain anticipated directional trends in tooth eruption. These may be desirable or undesirable. They may be exploited to advantage or controlled and reversed within limits.

Important also in the movement of teeth is the sequence with which certain changes are made. The occlusal factor must always be considered when work is being done in the individual arch. Any occlusal factor in an opposing arch which may inhibit or prevent desirable arch changes should be dealt with. This will serve not only to enhance and speed treatment, but also to minimize trauma on teeth being moved.

To become proficient in the use of the labio-loop-lingual appliance, one cannot avoid the necessity for developing precision and skill in appliance construction and adjustment. Appliance construction procedures common to other appliances cannot be used. Successful treatment demands that many cases be initiated in the transitional dentition. Commonly the first molars are incompletely erupted, yet have a deep, free gingival crevice. To attempt band construction in the mouth under these conditions would produce unsatisfactory results. Hence, a detailed laboratory procedure has been evolved for the fabrication of this appliance. When strictly adhered to, these procedures will produce an appliance of such standards that could not possibly be duplicated in the mouth. A skilled technician can be trained to carry out in detail the variations in appliance needed for individual case treatment. This releases the orthodontist from countless hours of mechanics and the patient from time-consuming appointments and trying experiences in the chair. It permits the orthodontist to devote his time more fully to case analysis and treatment. This ever-present and challenging area demands nothing less than the full measure of one's professional knowledge and ability. Orthodontics has been slow to recognize what orthopedics and ophthalmology have long since put into practice.

Being released from fabrication of appliances, the orthodontist can render professional service to a larger number of patients. This is a public health responsibility in which our profession has been remiss.

In the use of the labio-loop-lingual appliance, one must be extremely accurate in adjustments and control. In spite of its simple appearance, I believe it to be one of the most difficult appliances in inexperienced hands. If not used carefully, one can expand recklessly, distort, and destroy a case. One can

cause open-bites and override and destroy mandibular anchorage in Class II cases.

In this mechanotherapy, where so few teeth are banded, the problems of anchorage are far different from those of a multibanded technique. It becomes both important and necessary to use all the subtle resistance factors which may serve as a basis of anchorage. The fulcrum on which a tooth moves is contingent upon the relationship of the point of pressure application to the inherent resistance. It is necessary, then, to understand the critical points and the critical timing with which delicate forces are to be applied. In every case the minimum force necessary should be used to effect a movement. This force at all times must be sufficiently minimal to be absorbed and supported by the selected resistance or anchorage. In the initial use of this appliance, one must persevere with an inordinate amount of patience in dealing with the engineering and mechanical principles involved in its construction and use. Only then can one finally master the infinite number of appliance variations and adjustments that will produce nearly every conceivable tooth-movement without disturbing the selected anchorage.

The cases that I have presented here constitute only a small part of the number that have been treated with this appliance. I am aware that this is no singular feat, as many of you are able to obtain similar results. I hasten to assure you that every result in my practice is not of the quality that I have presented to this Society. There are some cases in which the facial asymmetry or skeletal problem was such that the maximum response falls short of orthodontic standards. There are others in which dental caries or persistent habits required a compromise in objectives; in which decisions were made to seek a maximum change, ignoring minor details for economic reasons; and in which minor rotations, such as a premolar, were ignored when the long retention was weighed against the high caries index. There have been other cases in which the patient's cooperation has not been adequate and, finally, there have been those in which my case analysis and treatment planning were at fault—my personal failures. Many failures result from faulty concepts and unrealistic objectives. Appliance therapy is important only in so far as it implements our concept of orthodontic objectives. These, after all, are of prime importance regardless of the nature or type of appliance used. In the continuation of this discussion in a subsequent article, I propose to deal both frankly and forthrightly with this matter.

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DISTURBANCES IN THE DEVELOPMENT OF THE UPPER JAW AND THE MIDDLE FACE

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PART I. HEREDITARY AND DEVELOPMENTAL FACTORS

A LARGE number of maxillary anomalies originate from disturbances of development, either from excessive growth or (more frequently) from inhibition of growth. It is evident that among the factors which can lead to an increase or retardation of growth of the jaws any which take part in the complicated process of the physiologic growth of the jaws can be responsible, such as the activity of the centers of growth, special hereditary tendencies of development, the endocrine glands, nutrition (especially the vitamins), deformative pressures of the surrounding regions, and traumas.

Disturbances of growth of the mandible can be traced fairly easily as the mandible's growth in length chiefly emanates from and is controlled by the cartilage of the temporomandibular joints. A too large mandible in some cases of progenia, a too small mandible in some cases of distoclusion and genuine open-bite, excessive anteroposterior growth of the mandible in cases of acromegaly, and a complete elimination of the center of growth in the temporomandibular joint after traumatic damage (either unilaterally or bilaterally) in cases of micrognathia are well-known examples of such abnormal development.

In the case of the upper jaw, on the other hand, the circumstances appear much more complicated. Although it is certain that many of the cases of malocclusion which we treat have been created chiefly by disturbances in the development of the upper jaw and middle face, up to now the precise causes have hardly been investigated. Contrary to the chondrogenic proliferative growth of the mandible in the centers of growth of the joints, the growth of the upper jaw and middle face is localized in the synchondroses of the base of the skull and in the sutures of the facial skull; that is, growth is effected by interstitial proliferation of the connective tissue lying in the sutures and finally by modeling apposition on the surface.

In this growth of the base of the skull the synchondroses sphenoethmoidea, intersphenoidea, sphenooccipitalis, and intraoccipitalis are chiefly concerned (Fig. 1), but some of them are mainly active during the period of prenatal development. For example, the intersphenoidal cartilage between the pre-

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sphenoid and the basisphenoid normally ossifies at the time of birth. The intraoccipital synchondrosis, which in the case of a youthful os occipitale separates the pars lateralis anteriorly from the pars basilaris and posteriorly from the squama occipitalis, disappears between the ages of 4 and 5 and becomes a synostosis; the sphenoethmoidal suture disappears, at the latest, at the age of 7 years. Thereafter only the sphenooccipital cartilage between the pars basilaris of the os occipitale and os sphenoidale remains active. This cartilage remains until about the eighteenth to the twentieth year and is, therefore, a very important basal growth cartilage. On the other hand, it is reasonable to assume that most of the disturbances of development which we observe are created by insufficient activity of the intersphenoidal and sphenoethmoidal synchondroses during the last month of fetal life and immediately after parturition.

As Weinmann and Sicher[28] have shown, the growth in these synchondroses of the base of the skull takes place in a manner similar to that of the tubular bones in the epiphyseal ridge. If the growth of the cartilage is inhibited, premature synostosis of the bones of the base of the skull results. This inhibition of growth and shortening of the base of the skull in a sagittal direction is, then, necessarily coupled with an underdevelopment of the upper and middle face and retrusion of the upper jaw.

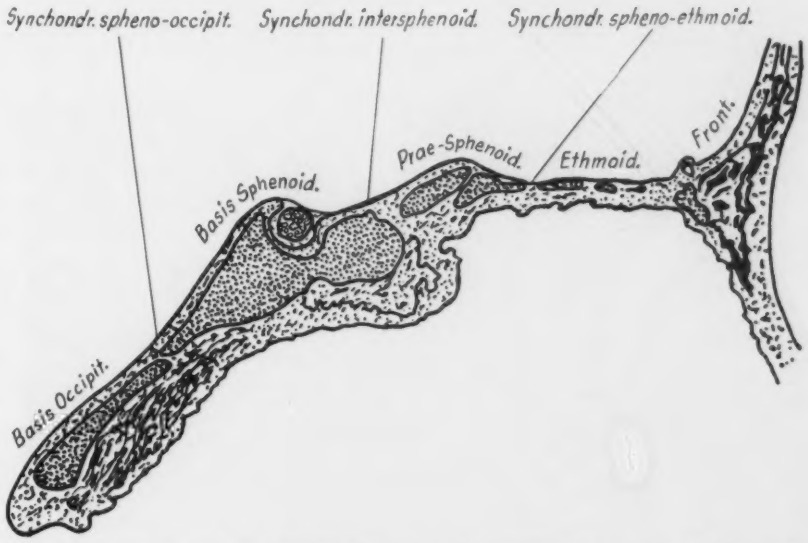

Fig. 1.—Synchondroses at the base of the skull (91 mm. embryos). (From Maronneaud, P. L.: *Cahiers Odonto-Stomatol.* 6: 17, 1956.)

On the other hand, the growth of the cerebral skull is chiefly dependent on the growth and the size of the brain. Even though there may be relationships between the development of the cerebral skull and the facial skull, which find expression in the ratio of the breadth of the forehead to the breadth of the zygomatic arch and in the transverse distance between the heads of the temporomandibular joints and therefore in the size of the angle of the mandible, the extent of growth of the cerebral skull is, on the whole, without influence on the facial skull.

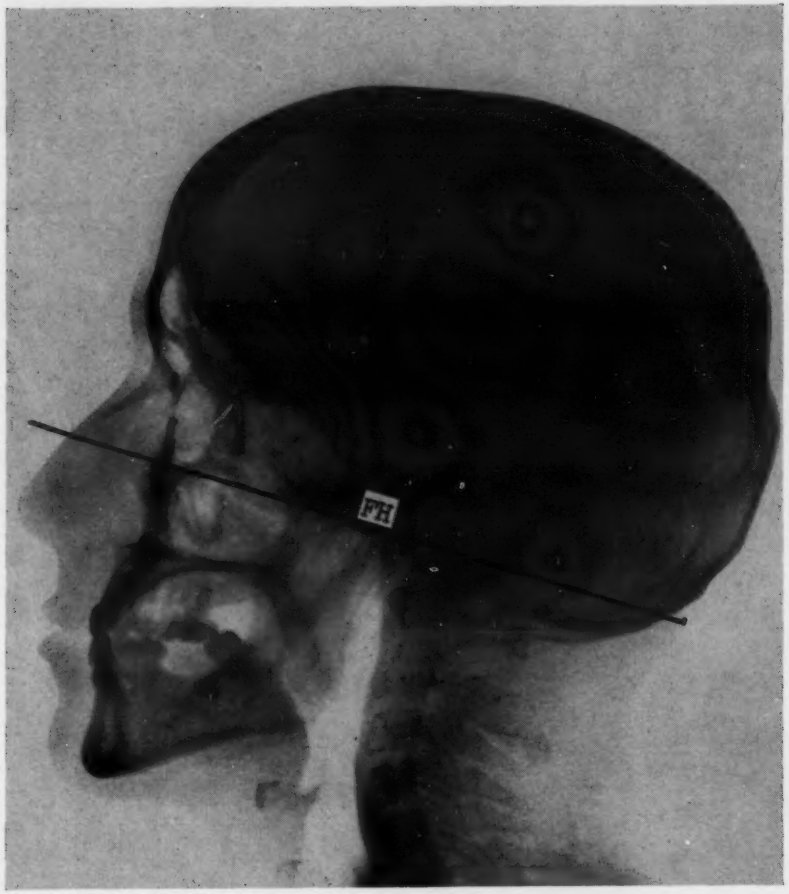

Fig. 2.

Fig. 3.

Fig. 2.—Hydrocephalus internus. Patient V. R., aged 30 years 8 months. Circumference of head 68 cm. Teleradiograph of profile (focus-film distance 13½ feet). Line *FH* represents horizontal position of head.

Fig. 3.—Frontal teleradiograph of patient in Fig. 2.

I would like to confirm this by some examples.

If there is an alteration in the fluid pressure, during a very early stage of embryonal development, which leads to a hydrocephalus internus (Figs. 2 and 3), that is to an extension of the cavities of the brain and the folds of the ventricles and corresponding extraordinary increase in the circumference of the head, the development of the facial skull is affected by this just as little as by the opposite case of microcephalia (Fig. 4). Some cases of microcephalia have been observed in which the capacity of the skull was reduced to one-fourth of normal. The facial skull and the remainder of the body, however, did not show any deviations. On the contrary, the full development of the splanchnocranium indicates an undisturbed activity of the synchondroses at the base of the skull and of the sutures responsible for the growth of the facial skull.

Fig. 4.—Microcephalia. Profile teleradiograph of Patient A. W., aged 24 years 4 months. Circumference of head 43 cm. Line *FH* represents horizontal position of head.

Because of their rarity, I should like to present the "Bonn Siamese twins," (craniopagus parietalis). Despite the abnormal state of the growth of the brain, they show a full and completely undisturbed development of the facial skull (Fig. 5).

It is a different matter if the growth of the cerebral skull is led in a certain direction by a premature ossification of single synchondroses at the base and single sutures of the skull. In such cases, various types of craniodysplasias

Fig. 5.—Craniopagus parietalis. Female patients 5 years 3 months of age.

result, among which turrecephaly (tower skull) is an especially prominent feature. Without going into details about the various shapes which the formation of a tower skull can create, I would like to state that the tower skull is undoubtedly a part of a whole complex of anomalies. It is a compensatory measure on the part of the brain; the size of the brain is chiefly inherited and, as a result of the retardation in the development of the base of the skull, the

Fig. 6.—Turrecephaly. Patient K. R.-I., aged 24 years 6 months. Standardized photographs of face and profile.

Fig. 7.—Teleradiograph of patient in Fig. 6. Line *FH* represents horizontal position of head.

brain must extend itself excessively in another direction. Since this shortening of the base of the skull is localized at the boundary between the cerebral and the facial skulls, the extensive retardations of growth of the facial skull are quite logical. The shortening by 1 to 1.5 cm. of the distance from nasion to sphenoidale, which normally amounts to between 6.3 and 7 cm. in the adult, creates an extensive hypoplasia of the facial skull, an underdevelopment of the os ethmoidale, reduction in size of the sinuses, and a hypoplastic retruded upper jaw.

Fig. 8.—Same patient as in Figs. 6 and 7. Upper and lower jaws from above and in occlusion.

The next case which I shall show is a classical example, involving a 24½-year-old man with a pronounced turrecephaly (Fig. 6). The base of the skull shows the typical characteristic of these cases, namely, a steep slope in an occipital direction (Fig. 7). The underdevelopment of the middle face and the upper jaw in an anteroposterior direction, linked with a normal mandible, have created a "false progenia." The marked torus palatinus and the transverse asymmetry of the upper jaw have led to a cross-bite on the left side (Fig. 8).

The tower skull has been observed fairly often in the case of mono-ovular twins, frequently in the case of only one of a pair of twins as the result of a disturbance in development which took place during fetal life. This is explained by the close crowding in utero to which the embryos of mono-ovular twins are subjected and which often leads to marked deviations in the shape of the head. Newborn mono-ovular twins, therefore, can have more differently shaped heads than binovular twins whose embryonal development was more favorable.

Two 50-year-old mono-ovular twins (E. and W. F.) afford a very interesting example for this phenomenon (Fig. 9). The first twin has a tower

skull of the type caused by environment and, in addition, shows pronounced secondary alterations of the facial skull so that one could doubt the identical heredity of the twins which, however, has been satisfactorily proved. The deformities are chiefly localized in the upper and middle face, as can be recognized by comparison of the teleradiographs (Fig. 10).

Fig. 9.—Mono-ovular twins, E. and W. F., with differently shaped heads. The first twin has a tower skull (originated in utero) and correspondingly pronounced secondary alterations of the facial skull.

The vertical development of the face is almost identical in both twins. The shape and extent of the rami of the mandible, the palate, and other parts show an amazing degree of similarity. In the case of the first twin, however, the skeleton of the middle face shows a pronounced underdevelopment in a sagittal direction, which is undoubtedly, connected with the shortening of the base of the skull. This underdevelopment of the skeleton of the middle face in a sagittal direction influences the anterior extension of the sinus maxillaris,

and of the floor of the nose, that is, the spina nasalis anterior, the orbits, and the shape of the covering soft tissues. Even the soft tissue parts of the nose and ear show corresponding differences in their position. The upper lip lies back in the first twin. The protruded upper incisors just meet the lower incisors in edge-to-edge bite. In the case of the second twin, who exhibits unimpeded growth of the base of the skull, the position of the lips is harmonious, from which it can be concluded that in the past there was a correct occlusion of the incisors (this man now wears prosthetic dentures).

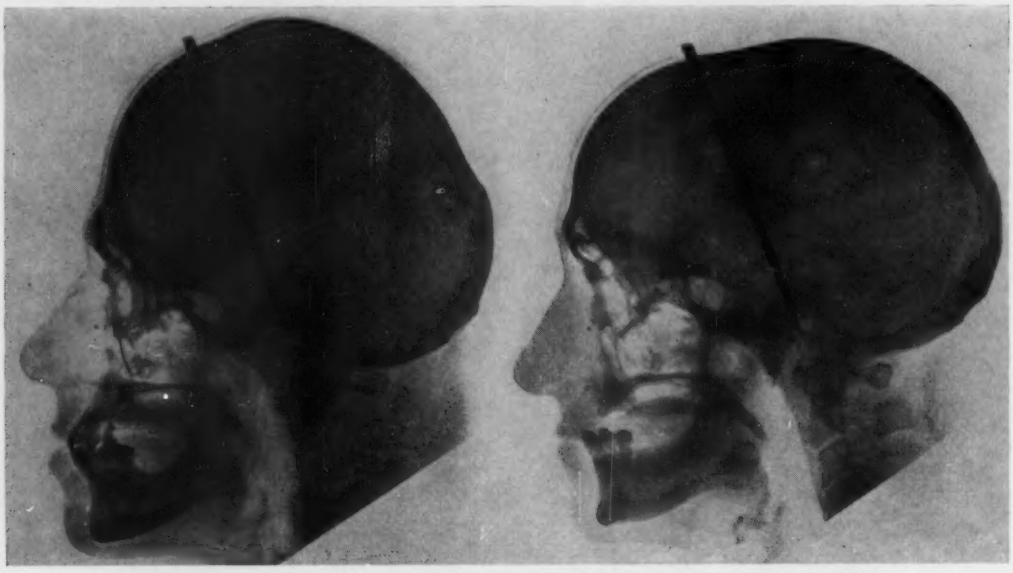

Fig. 10.—Teleradiographs of the mono-ovular twins, E. and W. F.

Profile tracings of teleradiographs, which were related to the basal line of De Coster (Fig. 11), reveal clearly the different length of the base of the skull, the corresponding difference in the position of sella turcica, and the difference in the shape of the profile. It is noteworthy that the occlusal plane and the lower border of the mandible are the same in height and direction.

The fact that the tower skull is frequently accompanied by further degenerative disturbances in development arouses the suspicion that endocrine causes, primarily the hypophysis, are at least partly responsible.[24] It is possible that this endocrine factor is secondary as a result of hereditary factors.

In this connection, chondrodystrophy is a very good example. This inhibition of development, which starts at a very early stage of embryonic life, is due to a hereditary dysfunction of the basicranial and epiphyseal growth cartilages. The growth in length of the extremities and of the base of the skull is strongly retarded. We see the typical characteristics of the achondroplastic dwarf, namely: extraordinary shortness of the extremities, normal development of the trunk, and a conspicuous shortness of the base of the skull with a sunken

root of the nose and a prominence of the forehead. The upper jaw is correspondingly underdeveloped and retruded. Since the mandible is developed normally, there is usually a "false progenia."

Weinmann and Sicher[28] explain this unimpeded growth of the mandible by assuming that the joint cartilage, which is covered by a thick layer of connective tissue, causes the growth of the ascending ramus of the mandible by apposition on the external surface rather than by interstitial proliferation. Since in cases of chondrodystrophy only the interstitial growth of cartilage (and not the appositional) is inhibited, the cartilage of the temporomandibular joint remains active while the epiphyseal cartilage of the long tubular bones stops growing and the synchondroses at the base of the skull ossify prematurely.

In a noteworthy article, Baume[2] has recently shown a typical radiograph of a case of chondrodystrophy (Fig. 12).

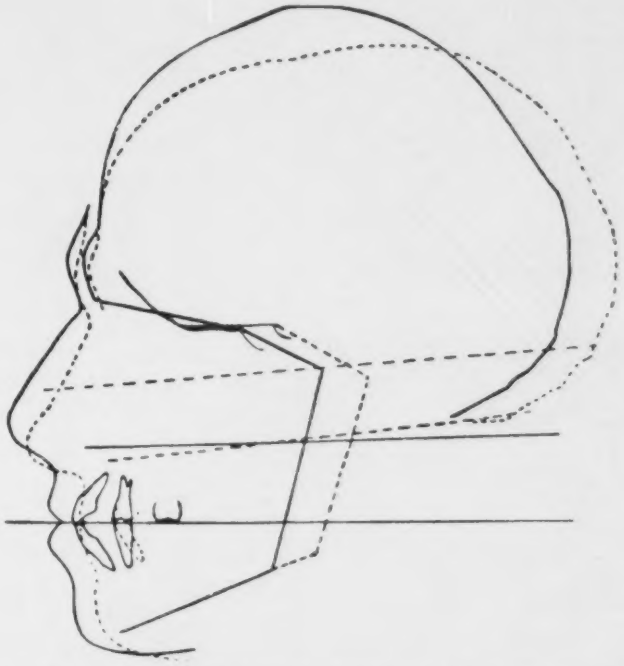

Fig. 11.—Outline tracings of the head teleradiographs of the mono-ovular twins F., related to the basal line of De Coster.

In connection with chondrodystrophy in human beings, I should like to mention the special races of dogs which have been created by breeding, such as the bulldog, the King Charles, and the Pekinese. The conspicuous disproportion between the short extremities and the normal trunk and between the upper face and the lower face in these dogs indicates a similar hereditary disturbance of bone growth. Also in the case of typical abnormal developments of the skeleton as seen in dysostosis cleidocranialis and dysostosis craniofacialis Crouzon, there are conspicuous disturbances of development at the base of the skull which have corresponding repercussions on the facial skull.

Fig. 12.

Fig. 13.

Fig. 12.—Radiograph of a 21-year-old patient with chondrodystrophy. Line *FH* represents horizontal position of head. (From Baume: Schweiz. Monatsschr. **66**: No. 4, 1956.)

Fig. 13.—Dysostosis cleidocranialis. Teleradiograph of Patient F. I., a girl aged 17 years. Line *FH* represents horizontal position of head.

The dysostosis cleidocranialis (Fig. 13) is a marked disturbance of the development of the skeleton, an insufficiency or entire lack of ossification mostly of the bones derived from connective tissue. Although the fontanels of the cerebral skull remain open a long period after the normal time and a premature synostosis of the cartilage ridges of the base of the skull doubtless should not be present either, the ossification is inhibited at an early stage. The brachycephalic head usually has a hypoplastic facial skull; the root of the nose has often sunk back, and the upper lip is retruded.

A very interesting characteristic is the persistence of the deciduous teeth and the retention of the permanent teeth, the number of which is sometimes doubled. The absence of the stimulus imparted by the erupting teeth, and hence the absence of the developmental stimuli which are normally imparted by the teeth to the masticatory apparatus, afford a further explanation for the marked underdevelopment of the upper jaw. Local causes, therefore, are added to the general ones which lie in the synchondroses and sutures of the facial skull as causes of these disturbances of development. K. H. Bauer[1] attributes this fortunately rare abnormality to a universal constitutional anomaly of all mesodermal tissues.

Fig. 14.—Dysostosis craniofacialis Crouzon in patient approximately 50 years old.

The inhibition of growth of the base of the skull and of the adjoining facial skull is even more pronounced in cases of dysostosis craniofacialis Crouzon (Figs. 14 and 15), a localized deformation of the bones of the head which is limited to the skull and which can be regarded as the counterpart of dysostosis cleidocranialis. Here we have premature ossification, frequently in utero, of the sutures of the skull. The anterior part of the base of the skull rises vertically; the sella turcica has a deep position so that this dysostosis has been referred to as a lordosis of the base of the skull. As a rule, there is a marked tower skull. At the location of the large fontanel a definite protuberance of

Fig. 13.—Dysostosis cleidocranialis. Teleradiograph of Patient F. L., a girl aged 11 years.

the bone indicates the "fontanel bump" which is typical for this constitutional anomaly.

The facial skull shows remarkable deformations. The forehead is low, and usually sloped. All parts of the facial skull are clearly underdeveloped. The cavities of the eyes are too small, so that even during early childhood there is a bilateral exophthalmos with slight ptosis of the eyelids. The upper jaw is compressed to a high degree and there is a pathologically high palate. The normally developed mandible is often in mesioclusion.

Fig. 15.—Dysostosis craniofacialis Crouzon. Teleradiograph of profile of patient in Fig. 14. Line *FH* represents horizontal position of head.

The deformation of the physiognomy in cases of dysostosis craniofacialis is very marked. The slanting forehead, the hooklike bend of the nose, and the posterior position of the subnasale with a jutting-out of the mandible create an appearance similar to the head of a bird.

In all these cases of inhibition of growth at the base of the skull three main symptoms regarding the effects on the facial skull can be differentiated:

1. A *shortening of the anteroposterior dimension* corresponding to the degree of shortening of the anterior part of the base of the skull

(nasion-sphenoidale). For the upper jaw this means that the distance between nasospinale and spina nasalis posterior is clearly shorter than it should be according to the age of the patient.

2. An insufficient forward development of the individual parts of the facial skull which expresses itself in a *pronounced backward position.*

3. An *outward bending of the anterior parts of the facial skull* so that the angle between the base of the upper jaw and the base of the skull is altered.

These symptoms are the same as those which Klatt[11] observed in the case of "mop heads" in dogs, pigs, cattle, and fish. We have here, then, the same "congestion of the facial skull," as he calls it.

Part II. Endocrine Factors, Vitamin Deficiencies, and Facial Clefts

The Endocrines.—If we look further among the factors which can cause a disturbance in the development of the facial skull, we can expect to find examples in cases of endocrine diseases. In cases of hypofunction of the thyroid gland, that is, in cases of cretinism, the synchondroses of the base of the skull and the sutures remain open. There is a general retardation of growth which also affects the cerebral and facial skull (the former, however, comparatively less than the latter).

The 33½-year-old female cretin in Fig. 16 is 72 cm. in height and weighs only 26 pounds. The head and the upper extremities are developed to only about two thirds their normal size. The lower extremities are extensively deformed and have deviated in growth. The teleradiograph of the head shows an extraordinary general disturbance of development. The sella is very small, but there is nothing in the make-up of the facial skull which indicates that the growth of the upper jaw in a sagittal direction has been especially retarded in comparison to the mandible. The underdevelopment of the middle face in a vertical direction is especially conspicuous. The sinuses are very small and the orbits are very close to the body of the upper jaw. Radiographs of the teeth show several retentions ($\underline{3}|$ and $\overline{2}|$) and bulbous thickening of the roots due to deposition of cementum, as well as progressive degeneration of the periodontal tissues (Fig. 17). The teeth, many of which have little alveolar support, have tipped, presumably under the influence of the very large tongue which has insured space for itself, especially in the mandible (Fig. 18).

In cases of myxedema, which is also due to hypothyroidism, there is again a pronounced hypoplasia of the middle face which is closely connected with an inhibition in growth of the anterior part of the base of the skull. Pankow[18, 19] to whom we are indebted for thorough research on these hypoplasias of the facial skull due to endocrine causes, has stated that in cases of myxedema a

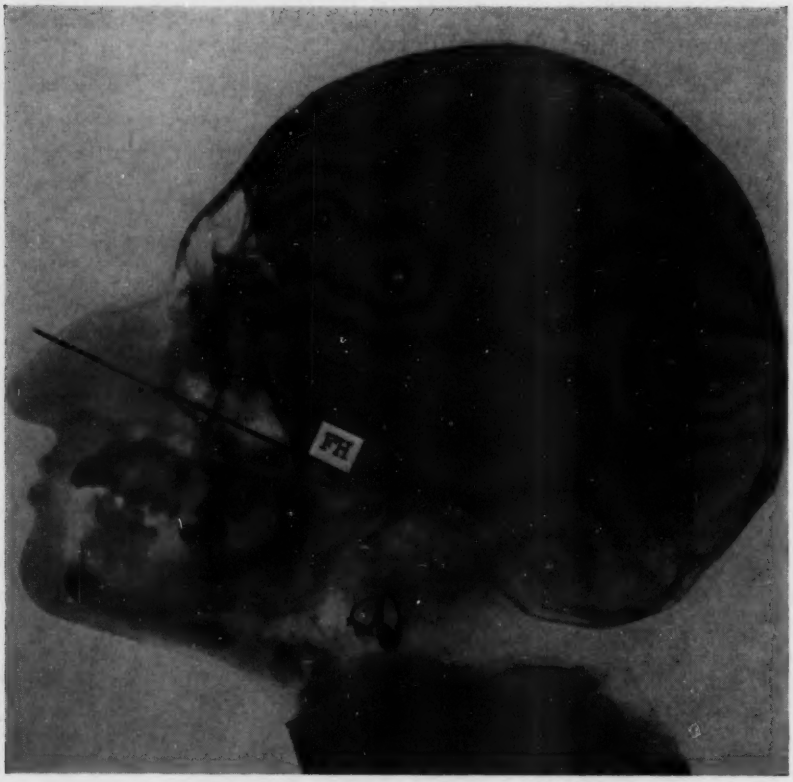

Fig. 16.—Hypothyroidism. Dwarfed female cretin, aged 30 years 8 months. Teleradiograph of the head.

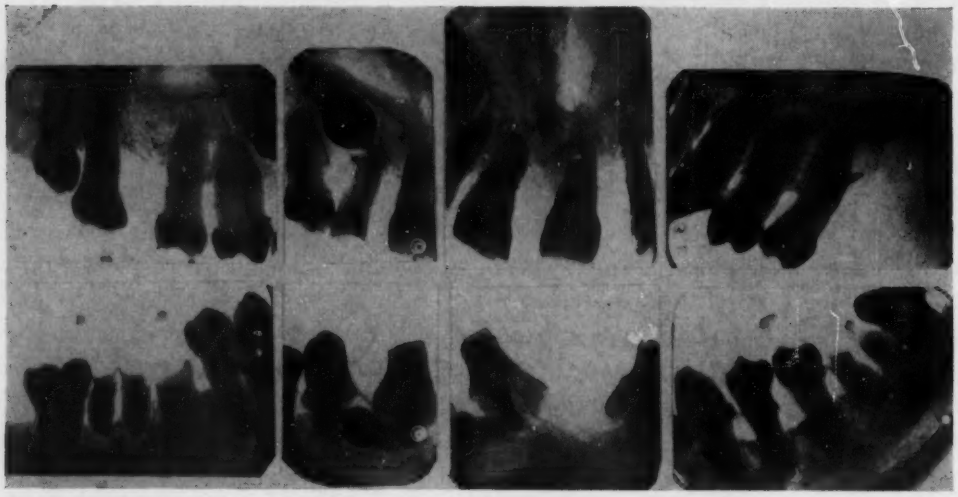

Fig. 17.—Complete set of radiographs of the teeth of the female cretin shown in Fig. 16.

hypoplasia of the infraorbital regions more than of any other can be observed. Furthermore, it is assumed that the very flat sphenoidal angle is a characteristic of the inhibition in growth.

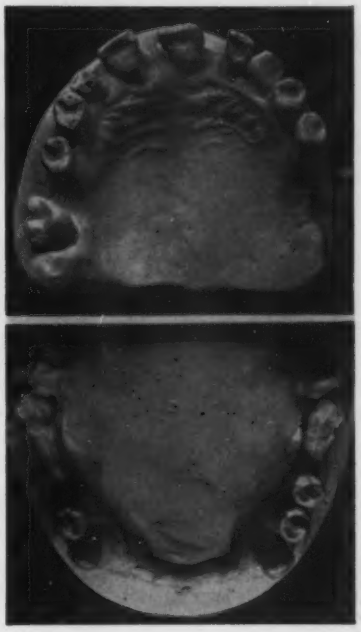

Fig. 18.—Jaw models of the cretin shown in Figs. 16 and 17.

Fig. 19.—Mongolism. Patient M. P. Age, 29 years 7 months; height, 146 cm.

As a final example of the influence of endocrine diseases on the growth of the facial skull, I should like to mention a case of Mongolism, although the pathogenetic relationships of this condition, which is linked with mental deficiency, are by no means clear.

The profile photograph (Fig. 19) of a 29½-year-old patient who learned to walk at the age of 5 and to speak at the age of 6 shows a sunken middle face with a sunken and broad root of the nose, which are in strong contrast to the jutting profile of the lips and of the chin. The teleradiograph (Fig. 20) clearly

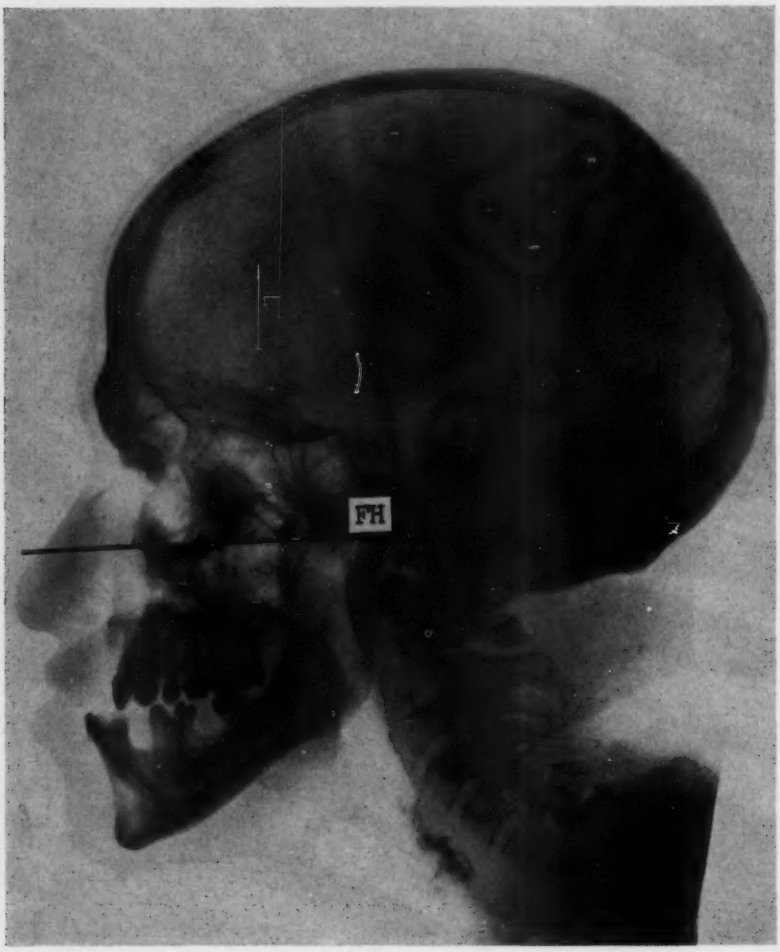

Fig. 20.—Teleradiograph of Mongoloid patient shown in Fig. 19.

shows a retardation of growth of all components of the upper and middle face accompanied by insufficient length and a retruded position of the base of the upper jaw. The corpus mandibulae, on the other hand, is well developed and reaches forward from the short ascending ramus so that the lower incisors bite approximately 1 cm. in front of the upper incisors; that is, there is a genuine progenia (Fig. 21). This extraordinary anteroposterior growth of the mandible is explained by the macroglossia which always accompanies Mongoloid degeneration, that is, by the abnormally large, cracked tongue. The left-sided compression of the upper jaw indicates an external pressure on this side, possibly due to a special manner of supporting the head during sleep.

Vitamin Deficiencies.—It is only a short step from disturbances of the endocrine secretion to cases of vitamin deficiency. The disturbances of growth due to vitamin D deficiency during early childhood, which can be observed especially on the skull, are too well known to make it necessary for me to go into great detail in this connection. The absence of calcification of the hyaline cartilage leads to important disturbances. The sutures remain wide open. The fontanels persist. The growth cartilages in the epiphyseal ridges of the ribs, but above all in the sphenooccipital, intersphenoidal, and intraoccipital synchondroses, and also the growth cartilage of the temporomandibular joints are all affected and permit only a limited growth in the regions of endochondral ossification. We can therefore expect the base of the skull, in cases of high-grade early rickets, to be reduced in its anteroposterior development. In children suf-

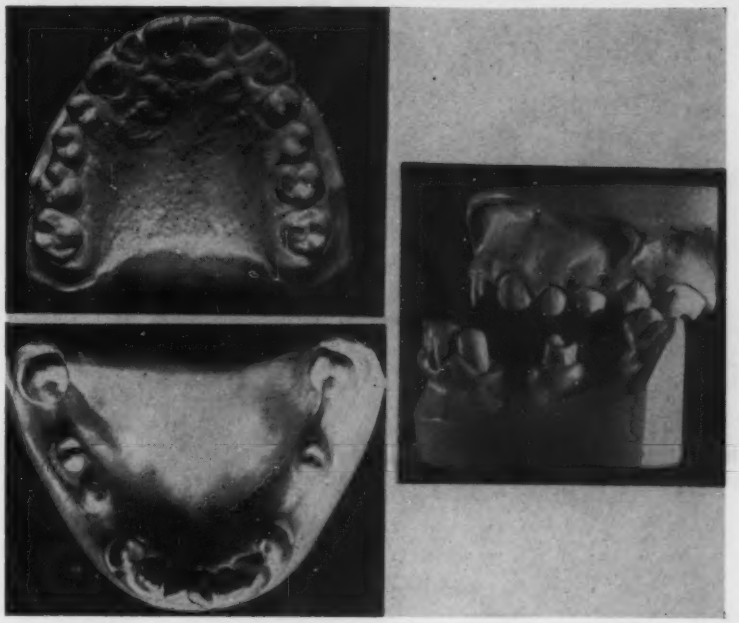

Fig. 21.—Same patient as in Figs. 19 and 20. Jaw models from above and in occlusion.

fering from vitamin D deficiency, the hypoplastic facial skull is often accompanied by a very prominent forehead. Weinmann and Sicher[27] attribute an especially important role to rickets in the disturbances of development of the facial skull: "Rickets seems to be one of the etiologic factors in facial disharmony."

In this connection, it may be of interest to mention also that in the case of rats with an artificially induced vitamin D deficiency there is a noticeable shortening of the facial skull and a sagittal underdevelopment of the upper jaw.[21] Schulz,[22] who has also worked on the abnormalities of the skulls of rats due to rickets, refers to a "brachycephal degenerative type." This same brachycephaly, which can be regarded as the persistence of a youthful shape, that is, as an inhibition of development, was created by Klatt[10, 11] and Krohn[13] by feeding the meat of cockles to the larvae of the pond salamander.

Fig. 22.—Skull of a cat with high-grade hunger osteopathia compared to skull of a healthy cat.

Fig. 23.—Genuine open-bite in the case of a 14-year-old female patient (W. I.).

I could make the same observation on the skull of a wild cat suffering from hunger osteopathia (Fig. 22). In this case the whole skull showed high-grade deformations, especially an unfavorable development of the middle face and of the alveolar process in all three dimensions, a conspicuous vertical tilting of the upper incisor region. Consequently, this skull was a typical brachycephalic degenerated type, as could be clearly recognized by comparison with the skull of a healthy animal.

This leads us to the similar disturbances of development in human beings. The most serious type of malocclusion due to rickets is, of course, the genuine open-bite. This anomaly shows always, at the same time, a high-grade narrowness of the jaws and is usually linked with inhibitions of growth due to prema-

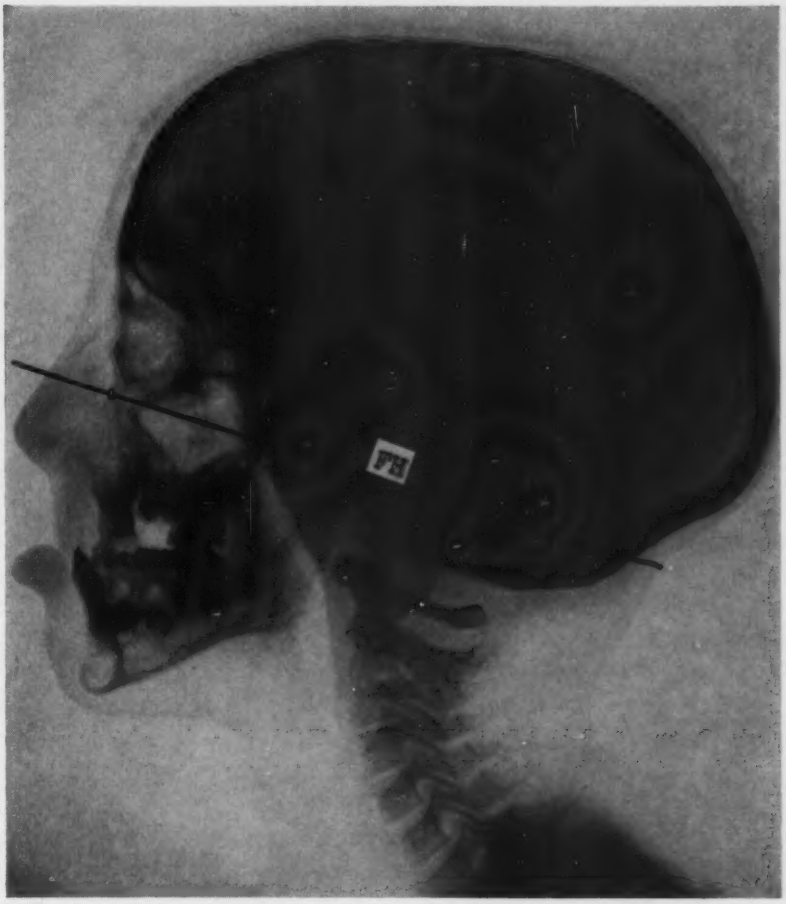

Fig. 24.—Cheilo-, gnatho-, palatoschisis in Patient M. F., aged 6 years.

ture loss of teeth. The extraordinary functional and cosmetic deficiencies which are associated with this type of malocclusion find especially grave expression in the high-grade inhibition of growth and deformations of the entire facial skull due to the vitamin D deficiency.

I should now like to show one of many examples of genuine open-bite.

The teleradiograph of the 14-year-old female patient W. I. (Fig. 23) shows the nature of these deformations. The shortness of the anterior part of the base of the skull, the insufficient anteroposterior development of the body of the upper jaw, the flatness of the angle of the mandible, and the shortness of the ascending ramus of the mandible can be regarded as characteristics of inhibition of growth due to rickets. According to Pankow, the flatness of the sphenoidal angle, which is often found in cases of genuine open-bite, can be regarded as a sign of retarded development.

Clefts of the Face.—We will now turn to the cases of cheilo-, gnatho-, and palatoschisis. The characteristics of these cases appear to be fairly easy to ascertain. A close investigation of the teleradiograph of young patients affected (Fig. 24) reveals that not only the immediate region of the upper jaw and of the nose are affected by the formation of the split, but that also the middle face and the base of the skull appear to be affected. In the case of older patients who have already undergone cheiloplastic and uranoplastic operations, the inhibiting action of the pull of the cicatricial tissue has acted additionally. The underdevelopment of the middle face and of the upper jaw can therefore be ascribed, in many cases, to the after effects of the surgical manipulations.

(This article will be concluded in the December issue of the Journal. References for the entire article will appear at that time.)

Erratum

In the article entitled "Analysis of Early Class II, Division 1 Treatment" by Eugene E. West, which appeared in the October issue of the JOURNAL, Fig. 3 on page 774 should have been as follows:

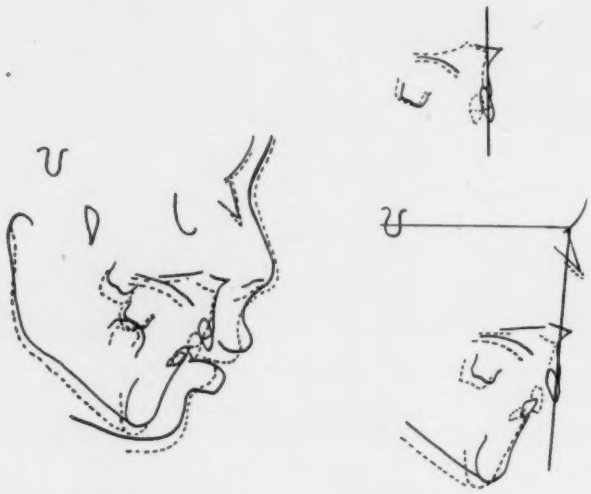

Fig. 3.—The broken line indicates changes which have taken place in a patient with an unfavorable facial growth.

Orthodontic Profiles

SIMEON HAYDEN GUILFORD

EVERY orthodontist should feel a certain amount of justifiable pride in what the pioneer orthodontists in the city of his birth or adoption have contributed toward the progress of our specialty.

Among the men whose profiles the editor of this JOURNAL has considered worthy of inclusion among the immortals of our specialty is Dr. Simeon H. Guilford who, prior to 1900, was among a group which included such illustrious men as N. W. Kingsley, J. N. Farrar, C. F. Dellabarre, E. H. Angle, Henry Baker, V. H. Jackson, F. A. Bogue, E. S. Talbot, C. S. Case, G. C. Ainsworth, C. S. Goddard, and C. W McGill. Dr. Guilford was one of that distinguished group whose hereditary background and personal achievements have left a legacy of dignity and respect for the profession in Philadelphia.

Dr. Guilford was born in Lebanon, Pennsylvania, on April 11, 1841, the son of Simeon and Catherine Elizabeth (Doll) Guilford. He died in his seventy-eighth year on Jan. 18, 1919, after a short illness, in the Samaritan Hospital in Philadelphia. His American ancestry went back to Paul Guilford, who came from England about 1650 and settled near Boston, Massachusetts. Dr. Guilford's grandfather, Simeon Guilford, served as ensign in the War of the Revolution, crossed the Delaware with General Washington, and was present at the execution of Major Andre. Dr. Guilford's father, a native of Northampton, Massachusetts, became a celebrated civil engineer, and was builder of the Erie Canal in New York and the Union Canal in Pennsylvania; he subsequently became an ironmaster and built furnaces in Schuylkill and Lebanon Counties in Pennsylvania.

Dr. Guilford received his preliminary education in the public schools and at Lititz Pennsylvania Academy. He was graduated from Franklin and Marshall College in 1861, with an A.B. degree; from that institution also he received an A.M. degree in 1864 and a Ph.D. in 1886. During the winter of 1861-62 he taught school. Then he entered the Union Army as a private in Company E, 127th Regiment, Pennsylvania Volunteer Infantry, which was attached to the third brigade, Second Division, Second Corps, Army of the Potomac. In the Civil War he participated in various engagements and battles, including those at Fredericksburg and Chancellorsville, and was mustered out toward the close of 1863.

He then began the study of Dentistry, and was graduated from the Pennsylvania College of Dental Surgery in 1865 with a D.D.S. degree. In 1884 he

received an honorary D.D.S. degree from the Philadelphia Dental College. Following his graduation, he began the practice of his profession at Lebanon and in 1872 he moved to Philadelphia, where he later resided and practiced. In 1880 he had temporary charge of a dental practice in Paris, France.

He was married on June 8, 1868, to Virginia Susan Gleim of Lebanon, Pennsylvania. They had one daughter, Mrs. William Dalzell of Pittsburgh, and one son, Dr. Dudley Guilford who, like his father, ranked among the top practicing dentists in Philadelphia prior to his death in March, 1949.

Dr. Guilford found his chief recreation in natural science, particularly in the fields of geology and mineralogy. His political affiliation was with the Republican party. He was a member of the Presbyterian Church.

Dr. Guilford resided for many years in Lansdowne, a suburb of Philadelphia, where he had as neighbors two other outstanding figures in Philadelphia dentistry—Dr. Edward C. Kirk, Dean of the Dental Department of the University of Pennsylvania, and Dr. Edwin T. Darby, Professor of Operative Dentistry at the University of Pennsylvania. Dr. Darby, one of the most distinguished clinicians of his day, had this to say of Dr. Guilford:

> Dr. Guilford was industrious. Few men have had the "work habit" more largely developed than he. Having inherited from his ancestors a strong constitution, he was able to work almost incessantly, as practitioner and teacher and Dean of the college, without apparent fatigue—and this, too, during a long period of years. During the fifty and more years of hard work he did much and did it well. He has left behind him an example for men to emulate. A large number of friends will remember him with pleasure and mourn his loss, and a host of students who listened to his teaching will remember with satisfaction that they were his pupils.

In June, 1915, Dr. Guilford organized and accompanied a unit of four from among the teachers in the Philadelphia Dental College (Temple University (which served for three months in the dental section of the American Ambulance Corps, Paris, ministering to the needs of wounded soldiers and repairing fractured jaws.

In 1881 he was elected to the chair of operative and prosthetic dentistry and orthodontia in the Philadelphia Dental College, and from 1896 to 1918 he was Dean of that institution, except for an interval of two years. He was the author of *Nitrous Oxide: Its Properties, Methods of Administration and Effects* (1887) and *Orthodontia* (four editions, 1889, 1893, 1898, and 1905); he wrote the chapters on Orthodontia, anomalies of the teeth and maxillae, and hypercementosis in *The American System of Dentistry* (1886) and chapters on preparation of cavities and contour fillings in *The Textbook of Operative Dentistry* (1900, 1903, 1905). He was a frequent contributor to dental journals, and was regarded as an authority on orthodontics. He was past president of the National Association of Dental Faculties, Pennsylvania State Dental Society, Odontological Society of Philadelphia, Pennsylvania, Philadelphia Academy of Stomatology, and National Institute of Dental Pedagogies and a past vice-president of the National Dental Association and National School of Dental

Technics. He was a member of the American Dental Association and American Dental Society of Europe, an honorary member of the Reading (Pennsylvania) Dental Society and Dental Society of Southern New Jersey, an associate fellow of the American Academy of Dental Science in Boston, and an associate member of the First District Dental Society of New York. He was also a member of Phi Kappa Sigma fraternity, the University Club, and Phi Beta Kappa.

It is very interesting to study Dr. Guilford's book, which was first published in the 1880's. It mainly presents a large number of illustrations of exactly the same kind of case problems with which we are faced in everyday practice at the present time, together with all kinds of mechanical devices and instructions on how to deal with them. Many of these appliances are from the works of Drs. N. W. Kingsley, E. H. Angle, Henry Baker, V. H. Jackson, C. S. Case, G. C. Ainsworth, and others, to whom he gave credit.

SIMEON HAYDEN GUILFORD

In reading Dr. Guilford's book on the subject of orthodontics, the impression is gained that the relationships which circumscribed empirical problems bear to a far more comprehensive concept of the total subject is conspicuous by its absence. They seem, by comparison, like preliminary local skirmishes prior to the development of full-scale battles.

Obviously a satisfactory answer to many problems then, as now, had not been found; that is apparent to every student of orthodontics. It can only be hoped that, as perspective widens, further progress may be made.

Dr. Guilford's impact on orthodontics was felt, of course, prior to the advent of Angle's classification, gnathostatics, and cephalometrics. Notwithstanding, during that early period Dr. Guilford practiced, on the whole, a very successful brand of orthodontics for many years. He used logic and common sense, and he had a keen appreciation of the facts with which he had to deal.

Dr. Guilford was one of the very important teachers and pioneers of orthodontics, particularly in the Philadelphia area. His teaching cast great influence on the tides of orthodontics during the period of the birth and growth of the first specialty of dentistry, and many students in dentistry received their orthodontic training under Dr. Guilford.

Andrew F. Jackson

In Memoriam

LESTER H. TATE
1886-1956

LESTER H. TATE of Canton, Ohio, died on Dec. 12, 1956. His death was due to a traffic accident.

Dr. Tate was born in Heflin, Alabama, and as a young boy moved with his family to Como, Mississippi, where he graduated from high school in 1903. Five years later he was graduated from the University of Tennessee with the degree of Doctor of Dental Surgery.

He began his practice of dentistry in Murfreesboro, Tennessee, and continued there for fifteen years, until he decided to specialize in orthodontics. He took his postgraduate work at the Dewey School of Orthodontics in New York City.

His first interest in Canton was aroused by a representative of the Harvard Dental Company, now the Weber Dental Manufacturing Company, who was present at a meeting in Nashville, Tennessee, which Dr. Tate was attending. This dental representative advised him to come to Canton to practice his specialty. After completing his postgraduate work, Dr. Tate visited Canton, Ohio, looked over the city, and decided that it presented a favorable opportunity. He moved to Canton in January, 1924, and there limited his practice to orthodontics.

Dr. Tate was a member of the First Baptist Church, Canton Club, Congress Lake Club, Elks Club, Canton Shrine Club, and the Y.M.C.A. He was a past president of the Stark County Dental Society and a member of the American Dental Association, the Great Lakes Society of Orthodontists, and the American Association of Orthodontics.

Dr. Tate assisted in organizing Trinity Lodge, F. and A.M., of which he was a charter member. He also belonged to Tadmor Temple and Nazir Grotto in Canton, and retained his Knights Templar and R.A.M. affiliations in Murfreesboro, Tennessee.

Surviving are his widow, Mrs. Ellen Love Tate; two sons, Lester H. Tate, Jr., of Canton, and Dr. James C. Tate, who was associated with his father in his dental practice; three daughters, Mrs. William Fenwick of Cleveland, Mrs. Harold Immel of Canton, and Mrs. David Shaeffer of St. Louis, Missouri; and ten grandchildren. Also surviving are six brothers, Charles C. Tate of St. Petersburg, Florida, Dr. Andrew Tate of Hattiesburg, Mississippi, Frank Tate of Seminole, Oklahoma, Fred Tate of Nicholasville, Kentucky, Joseph Tate of LaRue and Augustas Tate of Greenwood, Mississippi; and two sisters, Mrs. W. B. Langston of Clinton, Mississippi, and Mrs. Byron Gaskill of Joliet, Illinois,

Department of Orthodontic Abstracts and Reviews

Edited by

DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

Abstracts Presented Before the Research Section of the American Association of Orthodontists, New Orleans, May, 1957

The Incidence of Malocclusion in American Negro Children 12 to 16 Years of Age: By Leonard A. Altemus, B.S., D.D.S., M.Sc. (Dent.), Howard University, Washington, D. C.

The purpose of this study was to determine the incidence of malocclusion in Negro children attending the public schools in the District of Columbia. A total of 3,289 junior and senior high school children, ranging from 12 to 16 years of age, were examined. The children studied represented a cross section of all income groups. All the children had permanent dentitions and had received no orthodontic treatment.

The status of a child's occlusion was determined, using Angle's classification and the methods of Massler and Frankel. Normal occlusion was considered primarily as a dentition requiring no orthodontic treatment.

The findings showed that approximately 83 per cent of the group examined had some form of malocclusion. There was no significant difference in the incidence of malocclusion seen in boys and in girls. The percentage incidence in each category of Angle's classification was as follows: ideal occlusion, 3.69; normal occlusion, 12.79; Class I, 66.40; Class II, Division 1, 10.55; Class II, Division 2, 1.58; Class III, 4.99. A similar survey conducted by Massler and Frankel in 1951, using 2,758 Caucasian children, showed the following percentages: ideal, 2.93; normal, 18.23; Class I, 50.07; Class II, Division 1, 16.68; Class II, Division 2, 2.71; Class III, 9.43. The data compiled on the Negro children by Massler and Frankel's methods showed an average of six malocclueded teeth per child, whereas Massler and Frankel observed an average of ten malocclueded teeth per child in Caucasian children.

A comparison of the data of this survey with the data of the survey made by Massler and Frankel can be summarized as follows:

1. The over-all incidence of malocclusion in both surveys was high.
2. The number of children with ideal occlusion in both groups was small.
3. There seems to be a significant difference in the distribution of the various classes of malocclusion seen in the two groups.
4. The average number of malocclueded teeth per child was found to be less in the present study.

Anterior Open-Bite as Related to Condyle-Gonion Height and Hypoesthesia: By Leon L. Bolton, B.S., D.D.S., University of Tennessee, College of Dentistry, Memphis, Tennessee.

The purpose of the investigation was to find the correlation, if any, that exists between the height of the ramus (expressed as condyle-gonion height) and the extent of anterior open-bite and to determine also what relationship, if any, exists between hypoesthesia of the soft palate and open-bite malocclusion.

Five hundred forty-six untreated patients between 6 and 20 years of age were examined. All were tested for hypoesthesia of the soft palate, using wooden tongue-depressor blades.

Nineteen of the 546 patients had open-bites. The age range of the group possessing open-bite malocclusions was 8 years 8 months to 19 years 8 months. The group was examined both clinically and with cephalometric roentgenograms.

Tracings were made of the lateral headfilms and the following measurements were taken: (1) condyle to gonion, (2) palatal plane to incisal edge of maxillary central incisor, (3) palatal plane to incisal edge of mandibular central incisor, and (4) the difference between the latter two measurements. A correlation was then made of the condyle-gonion height to the linear anterior open-bite.

FINDINGS

1. The open-bite condition was found in all three classes of malocclusion (Angle).

2. Sex difference in facial dimensions was not significant.

3. The correlation of condyle-gonion height to anterior open-bite was +.1206.

4. It was significant that nine out of nineteen patients who had open-bite malocclusions also possessed hypoesthesia of the soft palate, whereas only twelve of the 527 patients who had other types of occlusion presented hypoesthesia of this area.

News and Notes

American Association of Orthodontists

The next meeting of the American Association of Orthodontists will be held at the Commodore Hotel, New York, New York, April 27 to May 1, 1958.

President: Franklin A. Squires, Medical Centre, White Plains, New York.

Secretary-Treasurer: Earl E. Shepard, 8230 Forsyth Blvd., St. Louis, Missouri.

American Association of Orthodontists, 1958 Research Section Meeting

Continuing the policy of recent years, one session of the program of the annual meeting will consist of ten-minute oral reports of research. Items submitted for this program by authors not in attendance may be read by title only. All persons engaged in research are urged to present the results of their studies at this session on April 29, 1958. Commodore Hotel, New York, New York.

Each participant is asked to prepare a 250-word abstract for publication in the AMERICAN JOURNAL OF ORTHODONTICS. Both the abstract for publication and the ten-minute oral report should be carefully prepared to present adequately the import of the investigation.

Forms for use in submitting the title and abstract will be sent to each dental school orthodontic department and to any individual requesting one. Please send the title and abstract as early as possible, but not later than Jan. 10, 1958, to Dr. Herbert I. Margolis, Department of Orthodontics, Tufts University School of Dental Medicine, 136 Harrison Ave., Boston 11, Mass.

Thomas D. Speidel, Chairman, Research Committee
School of Dentistry, University of Minnesota
Minneapolis 14, Minnesota

1958 Milo Hellman Research Award, American Association of Orthodontists

The annual prize essay contest of the American Association of Orthodontists is to be known henceforth as the Milo Hellman Research Award, by action of the Association at its 1957 meeting.

Eligibility.—Any member of the American Association of Orthodontists and any person affiliated with a recognized institution in the field of dentistry or associated with it as a teacher, researcher, undergraduate, or graduate student shall be eligible to enter the competition.

Character of Essay.—Each essay submitted must represent an original investigation and contain some new and significant material of value to the art and science of orthodontics.

Prize.—A cash prize of $500.00 is awarded for the essay judged to be the winner. The committee reserves the right to omit the award if, in its judgment, none of the entries is considered to be worthy. Honorable mention is awarded to the authors taking second and third

places. The first three papers will become the property of the American Association of Orthodontists and will be published. All other essays will be returned to the authors.

Specifications.—All essays must be in English, typewritten on 8½ by 11 inch white paper, double spaced with at least 1 inch margins. Each sheet must be numbered and bound or assembled firmly in a "brief cover" for easy handling. The title of the essay should appear on the "brief cover." Three complete copies of each essay, including all illustrations, tables, and bibliography, must be submitted. The name and address of the author must not appear on or in the essay. For identification of the essay, its title, its author's name, and a brief biographical sketch setting forth the author's professional training, present activity, and status (practitioner, teacher, student, research worker) must be typed on a separate sheet of paper and enclosed in a plain envelope. The title of the essay only must appear on the envelope.

Presentation.—The author of the winning essay will be invited to present it at the meeting of the American Association of Orthodontists to be held in New York, New York, April 27 through May 1, 1958.

Judges.—The entries will be judged by the Research Committee of the American Association of Orthodontists.

Final Submission Date.—No essay will be considered for this competition unless received in triplicate on or before Jan. 10, 1958, by Dr. William B. Downs, 314 North Lake St., Aurora, Illinois.

Thomas D. Speidel, Chairman, Research Committee
School of Dentistry, University of Minnesota
Minneapolis 14, Minnesota

American Board of Orthodontics

The next meeting of the American Board of Orthodontics will be held at the Commodore Hotel in New York, New York, April 22 through 26, 1958. Orthodontists who desire to be certified by the Board may obtain application blanks from the Secretary, Dr. Wendell L. Wylie, University of California School of Dentistry, The Medical Center, San Francisco 22, California.

Applications for acceptance at the New York meeting, leading to stipulation of examination requirements for the following year, must be filed before March 1, 1958. To be eligible, an applicant must have been an *active* member of the American Association of Orthodontists for at least two years.

American Association of Orthodontists
Registration of Nonmembers for Attendance at Annual Session

To insure full participation of all active members of the American Association of Orthodontists, the following classification of nonmembers eligible to attend and schedule of attendance fees, which will be charged at the time of registration, has been set up for the coming annual session of the Association at The Hotel Commodore, New York City, April 27 to May 1, 1958.

A. *No Attendance Fee.*

1. Full-time teachers in university dental schools.
2. Full-time graduate or postgraduate students in university orthodontic departments. It will be necessary to present a letter from the dean of the school certifying the status of the student.
3. Dentists from outside Canada or the United States of America who are members of recognized dental or orthodontic organizations.

B. *Attendance Fee—$10.00.*

1. Associate or junior members of constituent societies of the American Association of Orthodontists.
2. Recent graduates of university orthodontic departments who are in Government Service.

C. *Attendance Fee—$20.00.*

1. Recent graduates of university orthodontic departments who are not members of constituent societies of the American Association of Orthodontists.
2. Other guests.

Those persons who would be classified under the heading of C-1 or C-2 above are requested to apply to the chairman of the Credentials Committee at least sixty days before the session for proper forms, which will require (a) written endorsement by two active members of the A. A. O. in the applicant's vicinity, (b) that the applicant be a member in good standing of the American Dental Association, and (c) that the applicant never have been rejected for membership in any of the constituent societies of the A. A. O.

Those persons who would be classified under the headings of A or B would be required only to submit credentials identifying themselves as being in one of these categories at the time of registration. Advanced reservations, which are by far most desirable, can be applied for by clearing one's credentials with the Credentials Committee by March 1, 1958.

Registration under categories C-1 and C-2 will, of necessity, be limited.

C. Sterling Conover
Chairman of the Credentials Committee
1 East 57th St.
New York, New York

Central Section of the American Association of Orthodontists

The following officers have been elected by the Central Section of the A. A. O.:

President: Frederick B. Lehman
1107 Merchants National Bank Bldg.
Cedar Rapids, Iowa

President-Elect: John R. Thompson
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The next session will be held Sept. 29 and 30, 1958, at the Roosevelt Hotel in Cedar Rapids, Iowa.

Pacific Coast Society of Orthodontists

The twenty-fifth general meeting of the Pacific Coast Society of Orthodontists will be held Feb. 23 through 27, 1958, in Santa Barbara, California.

The Southern Section of the P. C. S. O. will sponsor a program featuring such names as Brodie, Straub, Ricketts, and many others. There will be table clinics, seminar sessions, essays, and entertainment including a Spanish barbecue, style shows, and social events for men and ladies.

Rocky Mountain Society of Orthodontists

The annual meeting of the Rocky Mountain Society of Orthodontists will be held Nov. 10 to 13, 1957, at Writers Manor in Denver, Colorado. The program will feature papers by Faustin N. Weber, Memphis, Tennessee; Nathan G. Gaston, Monroe, Louisiana; and Bob Meyer, Denver, Colorado.

Temple University School of Dentistry

Temple University School of Dentistry announces a course in orthodontics, which will be given under the direction of Dr. R. H. W. Strang, Jan. 19 to Feb. 1, 1958.

The course will be limited to active or associate members of the A. A. O., and will be limited to the edgewise technique.

Notes of Interest

Dr. John Mather Jackson wishes to announce the opening of his new office at 119 Coulter Ave., Ardmore, Pennsylvania, practice limited to orthodontics.

Dr. Lewis C. Pinney announces the opening of his new offices in the Pinney Building at 2919 Court St. at Congress, Saginaw, Michigan, practice limited to orthodontics.

David A. Slade, D.D.S., M.S.D., announces the opening of his office at 2002 Washington St., Wilmington, Delaware, practice limited to orthodontics.

Harry H. Sorrels, D.D.S., announces the new location of his office for the practice of orthodontics at 2751 Northwest Expressway, Oklahoma City, Oklahoma.

Howard E. Strange, D.D.S., and John J. Byrne, D.D.S., announce their partnership in offices located at 1912 West 103rd St., Chicago, Illinois, and 18227 Harwood Ave., Homewood, Illinois, practice limited to orthodontics.

Dr. Morris S. Weinstein wishes to announce that after Oct. 1, 1957, his practice will be limited to orthodontics, 57 Highland Rd., Rye, New York.

Forthcoming meetings of the American Association of Orthodontists:
1958—Commodore Hotel, New York, New York, April 27 to May 1.
1959—Statler Hotel, Detroit, Michigan, May 4 to 7.
1960—Shoreham Hotel, Washington, D. C., April 24 to 28.
1961—Denver, Colorado.
1962—Los Angeles, California.

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Pacific Coast Society of Orthodontists

(Next meeting Feb. 23-27, 1958, Santa Barbara)

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Secretary-Treasurer, Raymond M. Curtner – – – – 450 Sutter St., San Francisco, Calif.
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Rocky Mountain Society of Orthodontists

(Next meeting Nov. 11-13, 1957, Denver)

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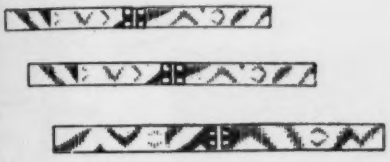

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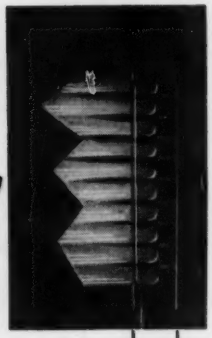

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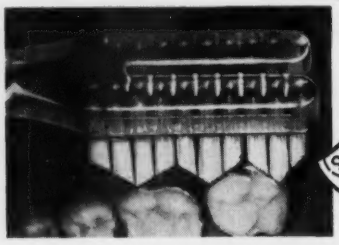

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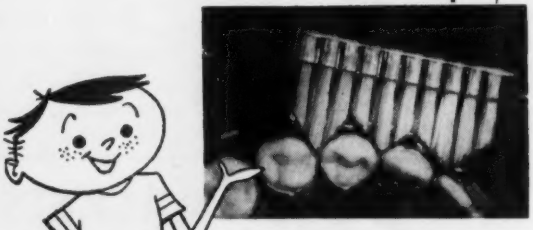

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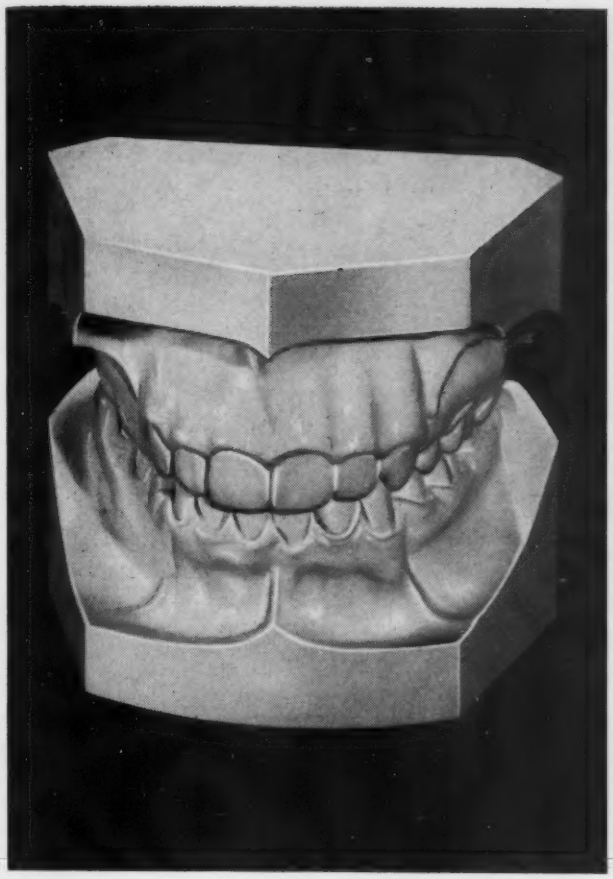

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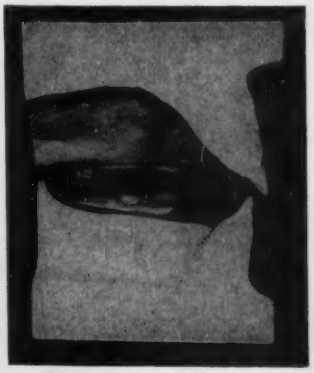

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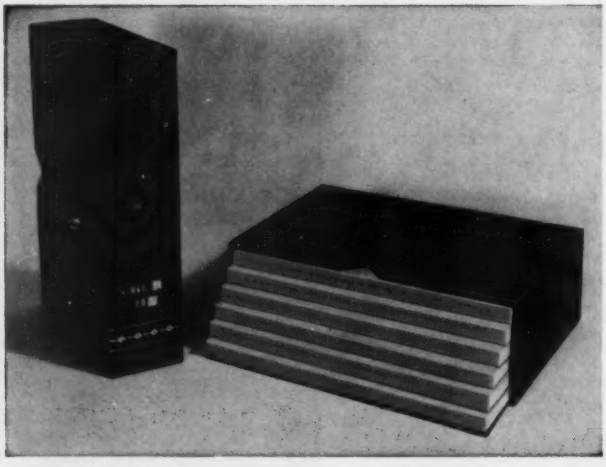

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Cettel Studios, The ---------- 21

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La Porte T-P Laboratories, Inc. ------ 7

Olympic Laboratories ---------- 21

Orthodontic Classified Advertisements - 20
Orthodontic Specialties Laboratory ---- 6

Rocky Mountain Metal Products ---- 15, 16

Specialists Laboratory for Orthodontists ---------- 24
Stratford-Cookson Company ---------- 18

Temple University School of Dentistry 23
Thrombley, Gilbert W. ---------- 11
Tufts University ---------- 19

Unitek Corporation ---------- 8, 9

White Dental Manufacturing Company, The S. S. ---------- Fourth Cover
Wilkinson Company, The ---------- 19
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